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NATIONAL DAM SAFETY PROGRAM. WIGGINS OZARK CAMP DAM (MO 30026),--ETC(U)
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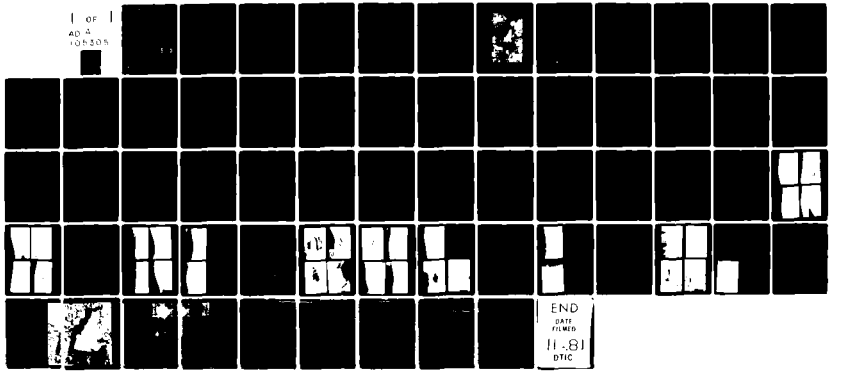

LEVEL

AD A105305

WHITE BASIN

WIGGINS OZARK CAMP DAM

REYNOLDS COUNTY, MISSOURI

MO 30026

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

PREPARED BY: U. S. ARMY ENGINEER DISTRICT, ST. LOUIS

FOR STATE OF MISSOURI

DECEMBER 1978

UNCLASSIFIED

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4. TITLE (and Subtitle) Phase I Dam Inspection Report National Dam Safety Program Wiggins Ozark Camp Dam (MO 30026) Reynolds County, Missouri		5. TYPE OF REPORT & PERIOD COVERED Final Report
		6. PERFORMING ORG. REPORT NUMBER
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9. PERFORMING ORGANIZATION NAME AND ADDRESS U.S. Army Engineer District, St. Louis Dam Inventory and Inspection Section, LMSED-PD 210 Tucker Blvd., North, St. Louis, Mo. 63101		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
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18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Dam Safety, Lake, Dam Inspection, Private Dams

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report was prepared under the National Program of Inspection of Non-Federal Dams. This report assesses the general condition of the dam with respect to safety, based on available data and on visual inspection, to determine if the dam poses hazards to human life or property.

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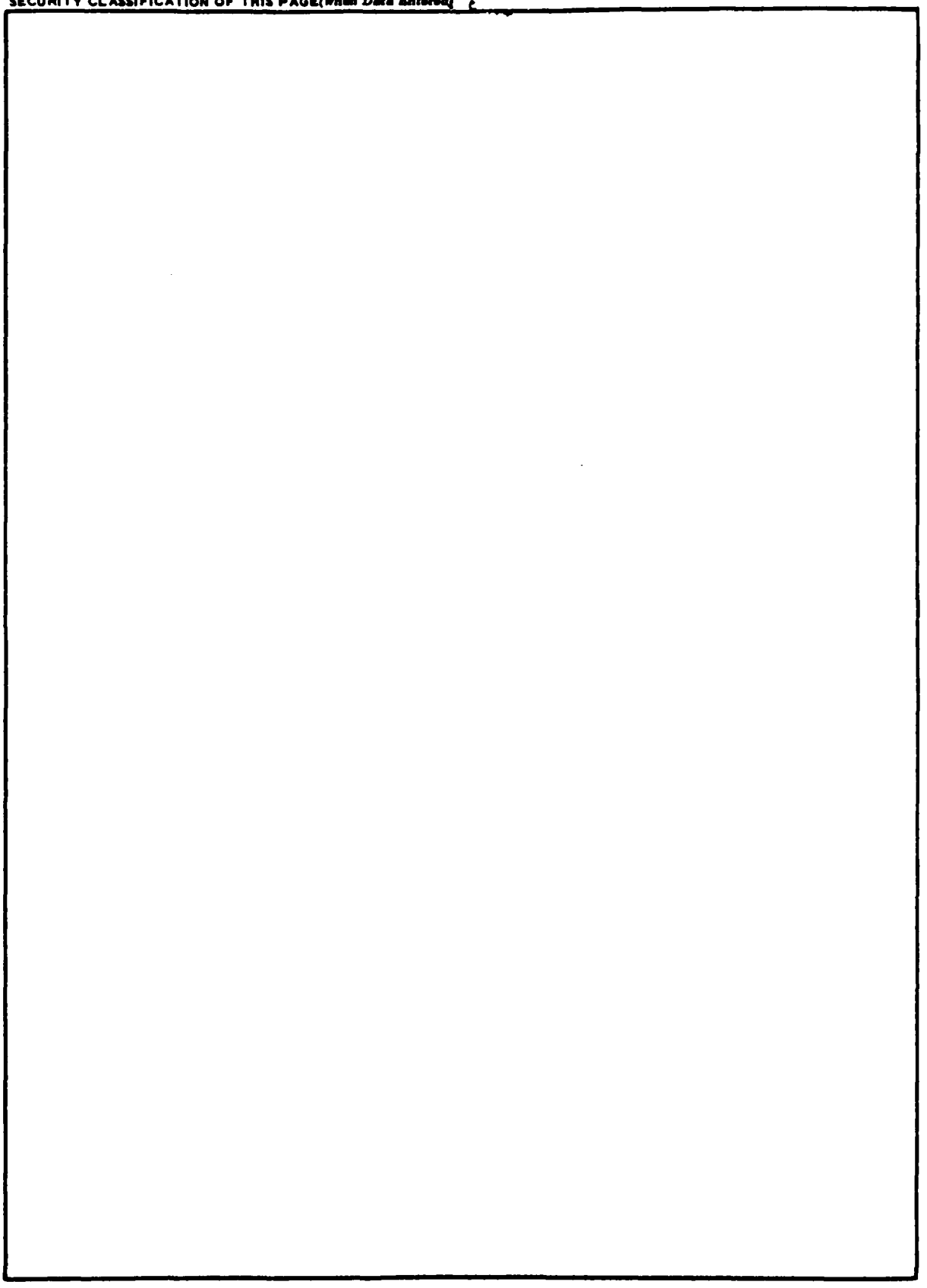

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DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
210 NORTH 12TH STREET
ST. LOUIS, MISSOURI 63101

IN REPLY REFER TO

SUBJECT: Wiggins Ozark Camp Dam, MO ID No. 30026
Phase I Inspection Report

This report presents the results of field inspection and evaluation of Wiggins Ozark Camp Dam, MO ID No. 30026.

It was prepared under the National Program of Inspection of Non-Federal Dams.

The St. Louis District has classified this dam as unsafe, emergency, requiring immediate attention because of a large slide on the downstream embankment slope, seepage on the downstream embankment slope and at the toe of the dam and a seriously inadequate spillway which will pass only 4 percent of the Probable Maximum Flood.

SUBMITTED BY. SIGNED
Chief, Engineering Division

20 MAR 1979
Date

APPROVED BY. SIGNED
Colonel, CE, District Engineer

21 MAR 1979
Date

PHASE I REPORT

NATIONAL DAM SAFETY PROGRAM

Name of Dam	Wiggins Ozark Camp Dam
State Located	Missouri
County Located	Reynolds County
Stream	Adams Hollow Branch of the Middle Fork of the Black River
Date of Inspection	20 November 1978 and 5 and 6 December 1978

Wiggins Ozark Camp Dam was inspected by an interdisciplinary team of engineers from Reitz & Jens, Inc. under contract with the St. Louis District Corps of Engineers. The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection to determine if the dam poses hazards to human life and property.

The guidelines used in the assessment were furnished by the Department of the Army, Office of the Chief of Engineers and developed with the help of several Federal and State agencies, professional engineering organizations and private engineers. Based on these guidelines, this dam is classified as a small dam with a high downstream hazard potential. The estimated damage zone from failure of the dam extends three miles downstream from the dam.

Failure would threaten the life and property of eleven families and cause appreciable damage to State Highway 72 and a county road crossing.

Our inspection and evaluation indicates that the dam is deficient in that the spillways do not meet the criteria set forth in the guidelines for a dam having the above size and hazard potential and which require that the spillway be capable of passing a one-half PMF (Probable Maximum Flood). The probable maximum flood is defined as the flood discharge that may be expected from the most severe combination of critical meteorological and hydrologic conditions reasonably possible in the region. The dam will begin to be overtopped by a flood having a discharge (peak and volume) equal to 3% to 4% of the PMF. The spillways will not pass a 1% chance flood (100-year flood) without overtopping the dam. A 100-year flood has a 1% chance of being exceeded in any given year.

Other deficiencies observed by the inspection team were seepage and/or under-seepage at the 2-inch pipe near the east end of the dam and an unstable downstream dam slope as indicated by earth placed as maintenance in a slide reported by Missouri Geological Survey in May 1978.

Seepage and stability analysis records were not available. This is a deficiency.

We recommend the owner take immediate action to correct or control the deficiencies described. A detailed report discussing each deficiency was prepared and submitted to the Governor of Missouri and to the lake owner.

HENRY M. REITZ, President
Reitz & Jens, Inc.

JOHN J. BAILEY, JR., Vice President
Chief Engineer
Reitz & Jens, Inc.

OVERVIEW - 30026

PLATE 1

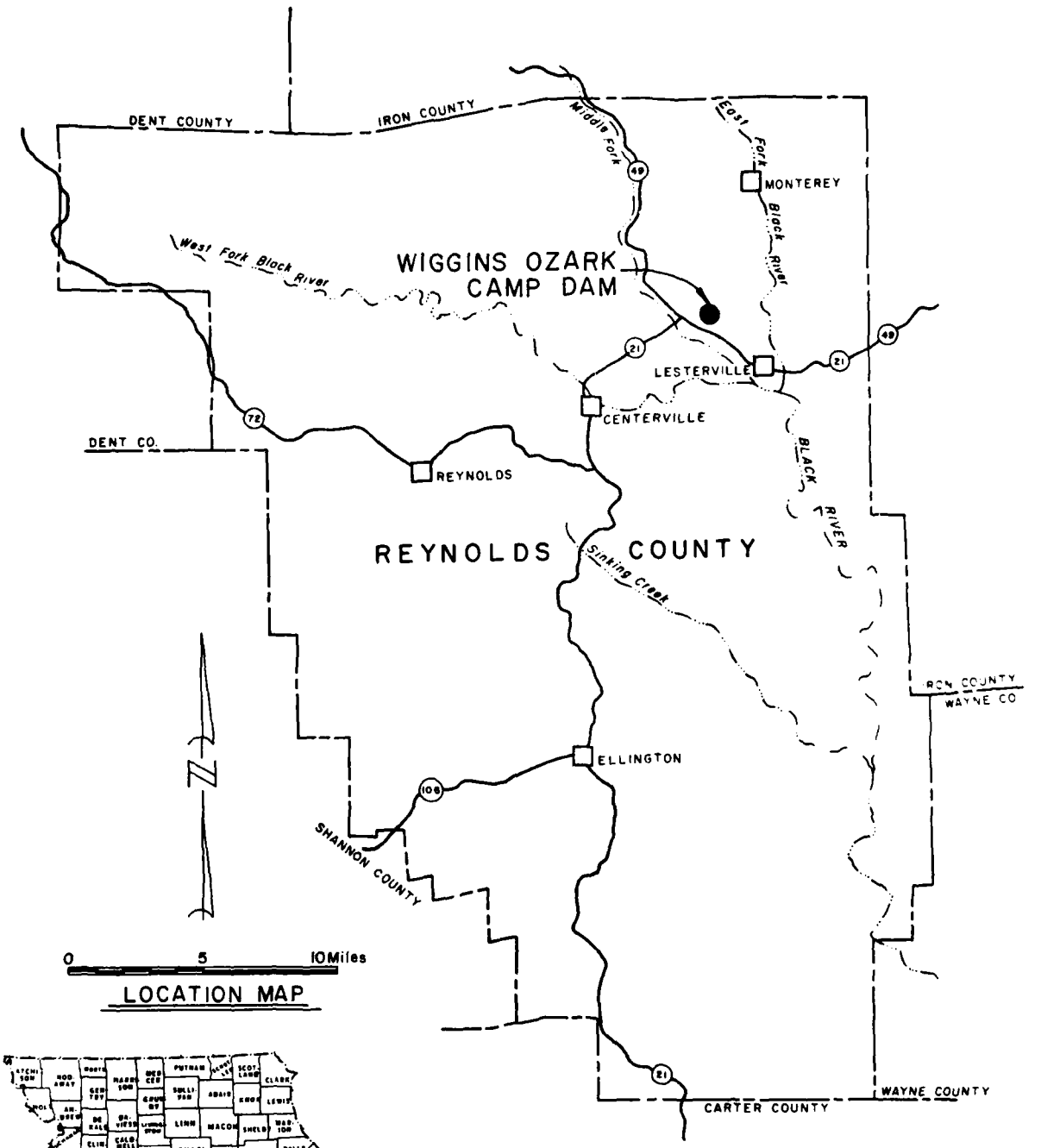
DENT COUNTY
IRON COUNTY
Middle Fork
East Fork Black River
MONTEREY
West Fork Black River
WIGGINS OZARK CAMP DAM
LESTERVILLE
CENTERVILLE
DENT CO.
REYNOLDS
BLACK RIVER
REYNOLDS COUNTY
Sinking Creek
RCN COUNTY
WAYNE CO
ELLINGTON
SHANNON COUNTY
N
0 5 10Miles
LOCATION MAP
CARTER COUNTY
WAYNE COUNTY
MISSOURI
0 100 Mi.

PLATE 2

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
Wiggins Ozark Camp Dam, MO ID No. 30026

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(Cont.)

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LIST OF INDICES AND PHOTOGRAPH NUMBERS

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority The National Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of safety inspection of dams throughout the United States. Pursuant to the above, the St. Louis District, Corps of Engineers, District Engineer contracted with Reitz & Jens, Inc. (Contract DACW43-78-C-0162) for a safety inspection of the Wiggins Ozark Camp Dam, MO ID No. 30026.

b. Purpose of Inspection The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection to determine if the dam poses hazards to human life or property.

c. Evaluation Criteria Criteria used to evaluate the dam were furnished by the Department of the Army, Office of the Chief of Engineers, in "Recommended Guidelines for Safety Inspection of Dams". These guidelines were developed with the help of several Federal agencies and many State agencies, professional engineering organizations and private engineers.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances

(1) The dam is an earth structure built in Adams Hollow about a mile upstream from the edge of the floodplain of the Middle Fork of Black River. The watershed extends about two miles north of the dam and consists of steeply sloping forested ground. Topographic relief is on the order of 250 feet except for Lee Mountain at the northeastern extremity of the watershed which has a maximum elevation of 1330 or about 550 feet above the damsite. Possibly 40 acres of Adams Hollow above the dam are cleared. There is a concrete chute principal spillway on the east end of the dam and a recently excavated, unlined earth channel emergency spillway at the east abutment.

Immediately upstream of the lake there is another smaller impoundment. This dam is about 500 feet long, about 15 feet maximum height and creates a 5-acre lake with between 25 and 40 acre feet of storage. Its spillway has concrete about 15 feet along the axis of the dam and about 2-1/2 feet vertical dimension. One or more signs of beaver activity were in the area of the dam. In November 1978, this dam and especially the spillway needed considerable maintenance.

Downstream of the main dam there are two concrete weirs constructed across the creek channel. These create small, shallow impoundments.

Topography in the vicinity of the dam is shown on Plate 3.

Pertinent physical data are given in paragraph 1.3 below.

b. Location The dam is located in the northeastern part of Reynolds County about two miles northeast of Lesterville as shown on Plate 2. The dam and lake are located in the N½ of Section 6, T32N, R2E, and shown on the USGS Lesterville Missouri Quadrangle Sheet, 1968 Edition. The dam is not shown on the 1943 edition of the Lesterville Quadrangle, 15-Minute Series.

Based on information received 24 January 1979 from Dr. James Williams, Missouri Geology and Land Survey, this dam is now owned by Mr. William H. Wenzel, 8000 Bonhomme Avenue, Suite 221, St. Louis, Missouri 63105.

d. Hazard Classification Guidelines for determining hazard classification are presented in the same guidelines referenced in paragraph c above. Based on referenced guidelines this dam is in the High Hazard Classification.

e. Ownership The dam is owned by Marion Wiggins, Ozark Camp, P.O. Box 180, Lesterville, Missouri. There is a proposal to buy this property by Sherwood Forest Camp, 7 North Seventh Street, St. Louis, Missouri, 63101.

f. Purpose of Dam The dam forms a 16-acre recreational lake.

g. Design and Construction History The inspection team was unable to find any design data on this dam. It was reported to the inspection team that a slide or slides had been repaired in the summer of 1968 and the emergency spillway described in paragraph 3.1.d had been excavated at that time. See Plate 4.

h. Normal Operating Procedure Normal rainfall, runoff, transpiration and evaporation all combine to maintain a relatively stable water surface elevation. The maximum water depth ever experienced at the spillway is unknown.

1.3 PERTINENT DATA

a. Drainage Area - 920 acres.

b. Discharge at Damsite -

(1) Discharge at the damsite is through two uncontrolled spillways and a 20-inch pipe under the dam controlled by a hand-operated valve.

(2) Estimated experienced maximum flood at damsite - unknown.

(3) Estimated ungated spillway capacity at maximum pool elevation -

(a) Principal spillway - 272 cfs

(b) Emergency spillway - 256 cfs
(c) Total - 528 cfs

c. Elevation (Feet Above M.S.L.)

(1) Top of dam - 783.5± (see Plate 3).

(2) Spillway crest -

(a) Principal concrete chute - 779.0

(b) Emergency spillway 780.3

(3) Streambed at centerline of dam - 755± (estimated from survey).

(4) Maximum tailwater - unknown.

d. Reservoir Length of maximum pool - 1800 feet (from aerial photo).

e. Storage

(1) Top of dam - 213 acre feet

(2) Crest of principal spillway - 127 acre feet.

f. Reservoir Surface

(1) Top of dam - 29.6 acres

(2) Spillway crest - 15.9 acres

g. Dam

(1) Type - earth embankment

(2) Length - 700 feet (from survey)

(3) Height - 28.5 feet maximum (from survey)

(4) Top width - 9 feet

(5) Side Slopes -

(a) Downstream - 1V on 2.5H average. Upper portion 1V on 1.6H (see section at Station 4+00, Plate 3).

(b) Upstream - 1V on 2H to water surface. Portions are steeper (see paragraph 3.2.b).

(6) Zoning - unknown

(7) Impervious core - unknown.

(8) Cutoff - unknown

(9) Grout curtain - unknown.

h. Diversion and Regulating Tunnel - None

i. Spillways

(1) Principal Spillway: concrete chute at east end of dam, 10 feet wide and four feet deep.

(2) Emergency Spillway: Unlined earth channel excavated in east abutment. Depth about three feet below top of dam. Bottom width about 22 feet. Top width about 55 feet.

j. Regulating Outlets Steel pipe with valve at toe of dam. At the discharge end, this pipe is 20 inches in diameter. The elevation of the upstream end is unknown as is the size of the pipe buried under the dam.

The upper end of this pipe was not visible when the water level was 4-1/2 feet below spillway crest.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

No design data were found to be readily available.

2.2 CONSTRUCTION

The dam appears to have been constructed sometime between 1950 and 1960. Recently, slides at the east end have been repaired and an emergency spillway channel has been excavated in the east abutment. This work was done after inspection by a State Geologist (see Plate 4).

2.3 OPERATION

The maximum loading on the dam is unknown. The lake level seems to remain stable during average precipitation of 38 inches per year. There are no records of operation of the dam. The present owners have opened the pipe through the dam to keep the lake level several feet below the spillway as a safety measure.

It appears, from the condition of the emergency spillway, that water has flowed through it at some time since completion.

2.4 EVALUATION

a. Availability No engineering data were available.

b. Adequacy No engineering data were available. Therefore, a detailed assessment of design, construction and operation could not be made. The owner should have an engineer, experienced in the design of dams, perform detailed seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams".

However, for the size of dam, materials used and measurements taken, a satisfactory hydrologic/hydraulic evaluation resulted. Also, for the section and presence of the primary spillway plus the visual inspection of a dam with reservoir of at least 15 years of age, the general condition of the dam, when considered by the experienced engineers, indicated that even though a detailed assessment of the design and construction in an analytical sense was not possible, a defensible evaluation of the dam as a structure was feasible.

c. Validity This report is primarily for safety through maintenance and operation and the conclusions and evaluation for this Phase I Inspection are considered adequate for the definitive statement in this report.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General A visual inspection of Wiggins Ozark Dam, Sherwood Forest Camp, was made on 20 November 1978. This inspection was followed by two days (5 and 6 December 1978) of field measurements by a survey party. The training and experience of personnel in the inspections included hydrologic/hydraulic engineering, soils and materials engineering, surveying and structural engineering.

b. Dam This is an earth dam. Both when inspected and during field surveys, the water surface in the reservoir was lower than the principal spillway, resulting from a decision by the owner to lower the lake to reduce probability of recurrence of dangerous slides. A report was available (see Plate 4) from the Missouri Geological Survey which summarized observations and recommendations from a site visit on 24 May 1978. A slide occurred earlier in 1978 in the vicinity of Stations 4+ to 5+. The visible earth tones of the maintenance show the location (D-8).

The top of the dam is narrow, about 9 feet wide (D-1,D-6,D-7,D-8). The downstream slope averages steeper than 1V on 2.5H with the upper half of the downstream slope approaching 1V on 1.6H(D-2,D-5). The upstream slope, while it averages approximately 1V on 2H above the lake surface, in some locations is considerably steeper (D-3,D-8).

An impression, while walking the dam, was that the top of dam has been raised sometime in the past. To maintain width of the raised top, the same upstream dam slope seems to have been continued without changing the toe location of the downstream slope. The raising appears to have been accomplished by steepening the upper portion of the downstream slope.

The top elevation of the dam is irregular; however, the maximum variation is about one foot except within 100 feet west of the concrete spillway where the top is as much as 2-1/2 feet below the lowest portion of the dam to the west of this portion.

Except for the east end of the downstream slope, where brush and small trees were growing, both slopes of the dam were free from any growth higher than a thick grass. No holes or similar signs of digging by animals were seen on any surface of the embankment. The absence of brush or tree growth on the dam surfaces makes an assumption of no animal activity and its probable adverse effect on the safety of the development credible.

On the downstream side of the dam, no areas of hydrophilic plants were observed. The material in the dam appears to have come from a borrow area downstream on the lower west slope of the valley and within the area of the reservoir. The general character of the borrow is residual soils from chemical weathering of the shallow bedrocks in the watershed. Some small rock probably will be mixed throughout the fills placed. Fine-grained soils with relatively low plasticities are the matrix of the fill.

c. Reservoir The shore around the lake, in most portions, was bare as a result of the recent drawdown of the lake surface (P-1,P-2,P-6). In general, the bank of the lake to the west is a gentle slope (P-1,P-2,P-6) without any tree cover except at the north end. The bank along the north end of the east

side (P-3,P-5) is a steep side of the hill with a virgin stand of trees. There is no armor-coating on the reservoir side of the dam (D-3,D-6,D-7,D-8).

Immediately above the end of the full pool formed by this dam is another dam which forms a 5-acre lake. The spillway for this up-valley dam and the embankment (overgrown with trees and brush and also has several signs of currently active beaver colony) need major maintenance to prevent a potential wash-out even if a thunderstorm of low annual probability occurred.

d. Spillways In the original construction, a concrete spillway with vertical sides and flat bottom was built at the east end of the dam (S-2, S-4,S-8,S-9). Width of the spillway was 10 feet; height of the sidewalls 4 feet with a longitudinal slope of 0.7% for a length of 37 feet at its entry and then an 80-foot chute at 6+%. The lower end of this spillway has collapsed and fallen (S-2,S-3) into an eroded ditch.

Maintenance around the concrete spillway has not been good.

As a precautionary measure, earlier in 1978, excavation of a wider emergency spillway in earth approximately 150 feet east of the concrete spillway was begun (S-5,S-7,S-10). The bottom of the earth section as excavated is about one foot higher than the invert of the concrete spillway. While the alignment of the spillway is rough, this 1978 excavation increases the capacity of spillways and helps to bypass flows before the dam is overtopped.

e. Valley Below Dam Two low, massive concrete weirs are built in the creek channel immediately down-valley, then the access road from Missouri Highway 21, then Missouri Highway 21, 4,000 feet south of subject dam and ultimately approximately 1/2-mile beyond the crossing of Missouri 21, the discharge from this valley enters the Middle Fork of the Black River.

The property with the dam was originally developed as a summer camp. Two residential units are at the edge of the valley on the west side and dormitories are on the slope up from the valley on the east side. A recreation service building is immediately downstream (V-1,V-2) on the west slope.

f. Seepage At the extreme east end of the dam, where the earth embankment meets the natural ground surface, seepage is visible (SE-1 thru SE-5). The seepage appears to be around and beneath a 2-inch steel pipe that in turn, was beneath a masonry sill. It is possible this was a location of a seep spring prior to construction of the dam. However, due to its location, it also could have a direct connection into the reservoir.

g. Low-Level Outlet The low-level outlet is a 5/8-inch thick, 20-inch outside diameter pipe at the lower end where it is visible and was flowing at the time of inspection (S-1,S-6,S-11).

h. Prospective Purchasers The Sherwood Camp interests which have a contract to buy this property recognize the deficiencies of this dam and have indicated to the inspection team that they intend to undertake remedial measures or remove the dam when they own the property. Their stated concerns are the instability of the embankment and inadequate spillway capacity. For these reasons, the lake surface has been lowered with the intent to keep it low until repairs and major modifications can be completed.

The Camp Sherwood interests have authorized the start of field investigations and engineering necessary for construction of remedial measures after their purchase of this property about the end of January 1978.

3.2 EVALUATION

The very inadequate spillway capacity, seepage, unstable embankment and low dam crest next to the principal spillway are individual safety deficiencies that could lead to failure of the dam. Existing in combination, they are cause for even greater concern regarding safety of the dam.

For the long, narrow valley with the lake more than 250 feet lower than the tops of bordering ridges,down-valley winds are not unusual. Valley winds with a 1500-foot fetch over the lake will develop waves. Erosion protection on the upstream slope is necessary from the top of dam to below the permanent pool elevation.

The work in the slide of earlier 1978 appears to have filled the depression on the dam slope which developed and is reported in the May 24 report of the Missouri Geological Survey. It is considered to have been temporary maintenance, not permanent repair.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

The owner is currently attempting to keep the pool low for the purpose of reducing slides (see paragraph 3.1.b).

4.2 MAINTENANCE OF DAM

Control of vegetation growing on the dam has been adequate except for a small area near the east end. However, maintenance of the embankment around the concrete chute spillway and channel downstream, where scour is undercutting the concrete, is deficient.

4.3 MAINTENANCE OF OPERATING FACILITIES

A valved 20-inch diameter steel pipe is through the dam. When the valve is opened, some of the water stored behind the dam can be drained lowering the lake level behind the dam.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT

The inspection team is not aware of any existing warning system for this dam.

4.5 EVALUATION

Continuing scour at the end of the concrete chute spillway may lead to eventual failure of the spillway and could cause a serious potential of failure of the dam.

The eroded portion of the dam crest west of the chute will allow flow over this portion of the dam embankment before full spillway capacity is utilized.

Reconstruction of this portion of the embankment, to assure full utilization of the existing spillway capacity, would not be difficult and should be completed immediately.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data No design data were available.

b. Experience Data The drainage area is developed from USGS Lesterville, Johnson Shut-Ins, Edgehill and Centerville, Missouri Quadrangles. Also available is a 1"=2000' aerial photo taken on 14 May 1978 by Surdex Corporation. Lake area is measured on a 1"=200' enlargement of a portion of one of these photographs and shown on Plate 1. The spillway and dam layout are from surveys made during the inspection.

c. Visual Observations

(1) The concrete chute principal spillway is in good condition except for the lower end where scour from discharge has caused partial collapse. Sliding and erosion has occurred on the west side of the principal spillway. Hydraulic calculations are based on this short portion of the embankment taken to be the top of dam for overtopping calculations.

(2) The emergency spillway and exit channel are located on the east abutment.

d. Overtopping Potential The spillways are too small to pass the minimum required flood of one-half the probable maximum without overtopping. The probable maximum flood is defined as the flood discharge that may be expected from the most severe combination of critical meteorologic and hydrologic conditions reasonably possible in the region. The dam will start to be overtopped by a flood equal to 3% or 4% of the PMF as it existed and 9% of the PMF is limited local maintenance at the west edge of the concrete spillway. The one-half PMF will overtop the dam to a maximum depth of about 2.3 feet.

Maximum rate of flow over the dam crest will be about 4400 cubic feet per second. Overtopping flow will have a duration of about 8 hours. The dam will be overtopped 0.9-foot by a 100-year frequency flood.

The integrity of the dam during maximum spillway releases cannot be assured.

There is a low dam and 5-acre lake immediately above this impoundment. The volume of water stored in this impoundment is 25 to 40 feet. Failure of this impoundment, in the opinion of the inspection team, would not have a significant impact on the hydrologic or hydraulic analysis related to the one-half PMF.

The effect from rupture of the dam could extend approximately three miles downstream of the dam. There are 11 inhabited homes downstream of the dam which could be severely damaged and lives of the inhabitants lost should failure of the dam occur.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations Visual observations which adversely affect the structural stability of this dam are discussed in Section 3, paragraphs 3.1.b and 3.1.f.

b. Design and Construction Data No design or construction data relating to the structural stability of the dam were found.

c. Operating Records With the exception of the valve on the low level outlet pipe, no appurtenant structures requiring operation exist at this dam. No records of operation of this valve are available.

d. Post Construction Changes The apparent attempt to raise the top of dam by steepening the downstream slope and possibly reducing the top width has contributed to the instability of the downstream slope. Recent maintenance of the slide location described in the State Geologist's report was not adequate, in the opinion of the inspection team, to stabilize this portion of the embankment. This is because the limited lateral extent of the bare earth suggests filling on or against a surface that had slid, a maintenance function not a permanent repair by digging out and replacing the mass of soil in the slide.

e. Seismic Stability Considering the seismic zone (2) in which this dam is located, an earthquake of this magnitude is not expected to cause a structural failure of this dam.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety The spillways are inadequate to pass the required one-half Probable Maximum Flood (PMF). Considering the volume of water stored and the valley downstream the one-half PMF is the appropriate spillway design flood.

Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available which is considered a deficiency.

Other safety deficiencies observed by the inspection team were a filled slide location on the downstream slope of the dam and seepage and/or underseepage at the 2-inch pipe.

Several items were noted during the visual inspection by the inspection team which should be corrected or controlled. An armor-coat to protect the reservoir slope of the dam against wave-wash is needed. Erosion protection for the primary spillway is deficient. A portion of the dam crest near the spillway is low and should be raised. The concrete spillway is being undercut by scour at its lower end.

b. Adequacy of Information Due to the lack of engineering design and construction data, the conclusions in this report were based on performance history and external visual conditions. The inspection team considers these data sufficient to support the conclusions herein.

c. Urgency The remedial measures recommended in paragraph 7.2 should be accomplished in the near future. If the safety deficiencies listed in paragraph a are not corrected in the near future, they will continue to deteriorate and lead to a serious potential of failure.

d. Necessity for Phase II Based on the results of the Phase I Inspection no Phase II Inspection is recommended.

e. Seismic Stability This dam is located in Seismic Zone 2. An earthquake of this magnitude is not expected to be hazardous to this dam.

7.2 REMEDIAL MEASURES

a. Recommendations The owner should obtain the services of an engineer experienced in the design and construction of dams to design and observe construction of remedial measures including the following:

(1) Spillway size and/or height of dam should be increased to pass the one-half Probable Maximum Flood (PMF) without overtopping the dam.

(2) Stability and seepage analyses should be performed and appropriate measures designed and constructed to control seepage and underseepage and to

stabilize the downstream slope of the dam. These may include berms, filters and/or drains and constructing a flatter downstream slope.

(3) If the designs under paragraph 7.2.a(1) include continued use of the concrete chute spillway and the present emergency spillway, scour protection at the end of the concrete spillway should be provided and an erosion-resistant sill should be provided in the emergency spillway.

(4) An armor-coat to protect the upstream face of the dam from wave-wash should be provided.

b. O&M Maintenance and Procedures The following O&M maintenance and procedures are recommended:

(1) Raise top of dam adjacent to concrete chute spillway.

(2) Improve control of vegetation growth on the downstream slope of the dam by removal of brush and mowing at sufficient intervals to control future growth.

(3) Periodically check the condition of the steel outlet pipe through the dam for evidence of corrosion and leakage. Water leaking into or out of a corroded outlet pipe could cause piping failure of the earth embankment.

(4) After completion of the remedial measures, detailed inspection of the dam should be made periodically by an engineer experienced in the design and construction of dams. Records should be kept of these inspections and major maintenance.

APPENDIX A

HYDROLOGIC COMPUTATIONS

HYDROLOGIC AND HYDRAULIC ANALYSIS METHODOLOGY

1. The hydrologic analysis used in development of the overtopping potential is based on applying a hypothetical storm to a unit hydrograph to obtain the inflow hydrograph for a reservoir routing. The Probable Maximum Precipitation for those dams in the high hazard potential category is derived and determined from regional charts prepared by the National Weather Service in "Hydrometeorological Report No. 33". Reduction factors have not been applied. A 24-hour storm duration is assumed with the 24-hour rainfall depths distributed over 6-hour periods in accordance with procedures outlined in EM 1110-2-1411 (SPF Determination). The maximum 6-hour rainfall period is then distributed to hourly increments by the same criteria. Within-the-hour distribution is based upon NOAA Technical Memorandum NWS HYDRO-35. The non-peak 6-hour rainfall periods are distributed uniformly. All distributed values are arranged in a critical sequence by the SPF criteria. The final inflow hydrograph is produced by deduction of infiltration losses appropriate to the soil, land use and antecedent moisture conditions.

2. The reservoir routing is accomplished by using Modified Puls routing techniques wherein the flood hydrograph is routed through lake storage. Hydraulic capacities of the spillways and crest of dam are used as outlet controls in the routing. Storage in the pool area is defined by an elevation-area curve. The hydraulic capacity of the spillways and the sloping top of dam is defined by a composite elevation discharge curve.

3. The dam overtopping analysis has been conducted by hydrologic methods for this dam and lake. This computation determines the percentage of the PMF hydrograph that the reservoir can contain without the dam being overtopped. An output summary in the hydrologic appendix displays this information as well as other characteristics of the simulated dam overtopping.

4. The above methodology has been accomplished for this report using the systemized computer program HEC-1 (Dam Safety Version), July 1978, prepared by the Hydrologic Engineering Center, U.S. Army Corps of Engineers, Davis, California. The numeric parameters estimated for this site are listed on Plate 1A. Definitions of these variables are contained in the "User's Manual" for the computer program.

5. Capacities of the spillways were calculated using critical depth at the hydraulic control sections. Energy grade or reservoir elevation was determined by adding critical velocity head plus 0.2 velocity head to allow for velocity distribution, velocity head changes and friction back to the reservoir. The control section for the concrete chute was at its upper end and for the emergency spillway at its crest near the dam centerline.

6. The upstream dam was included in the hydrologic and hydraulic calculations using the HEC-1 computer program as detailed on the attached input-output sheets listed in Plate A-1. In the opinion of the inspection team's hydraulic-hydrologic engineers, the effect of rupture of this dam would have little effect on the conditions existing during a one-half PMF because of the relatively small volume of water impounded.

7. Discharge over the irregular top of dam (the crest is not level) was calculated using a coefficient of 3.0 in the broad-crested weir equation for the sections of dam crest at different elevations. All spillway and overtopping discharges were included in a composite rating curve. Dummy values of 0.1 for dam length, coefficient of discharge and exponent were entered on the $D card to suppress diagnostic statements in the output. The amount of this dummy flow is never greater than 0.02 cfs.

```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  3 AUG 78
**********
    1                A  ********** ID # 30026 WIGGINS OZARK CAMP DAM **********
    2                A  ********** DAM SAFETY PROGRAM - U. S. CORPS OF ENGINEERS **********
    3                A  ********** REITZ & JENS, INC. -    SEPTEMBER 1978 **********
    4                B    288       0         5        -0       -0       -0       -0       -0       -4       -0
    5                I      5
    6                I      1         6         1
    7                J1  0.02      0.03      0.04      0.05     0.50     1.00
    8                K      0         1                             1        3        1
    9                1  ***** INFLOW HYDROGRAPH - SCS METHOD *****
   10                M      1         2    1.052                               1                          1
   11                P              26.6       101       120      130
   12                T                                                                  -1       -88                0.02
   13                W2             0.40
   14                X             -0.20      2.0
   15                K      1         2                             1        2        1
   16                1  ***** RESERVOIR ROUTING - SPILLWAY AND DAM EQUATIONS **********
   17                Y                                       1        1
   18                Y1     1                                                  -795.0
   19                $A  0.00       5.0       9.0      31.0
   20                $F   780       795       800       820
   21                $S 795.0      15.0       3.2       1.5
   22                $D 797.5       3.0       1.5     500.0
   23                K      0         3                             1        3        1
   24                1  ***** SUB-AREA DIRECTLY TRIBUTARY TO WIGGINS DAM *****
   25                M      1         2   0.388                               1                          1
   26                P              26.6       101       120      130
   27                T                                                                  -1       -85                0.08
   28                W2             0.20
   29                X             -0.10      2.0
   30                K      2         4                             1        2        1
   31                1   ***** COMBINED HYDROGRAPH *****
   32                K      1         5                             1        2        1
   33                1  ***** RESERVOIR ROUTING - RATING CURVE SUPPLIED - SLOPING DAM *****
   34                Y                                       1        1
   35                Y1     1                                                  -779.0       -1
   36                Y4 779.0     779.2     779.5     780.0    780.6    780.8   780.95    781.0    781.2    781.5
   37                Y4 781.8     782.0     782.5     783.0    783.7    784.2    784.5    785.0    786.5    787.5
   38                Y5   0.0       3.0       9.0      27.0     56.0     66.4     79.0     82.5    103.0    149.8
   39                Y5 216.0     278.0     480.0     753.0   1323.0   2026.0   2675.0   4010.0   8938.0  12230.0
   40                $A   0.0     15.91      17.3      53.3
   41                $F   755       779       780       800
   42                $S 779.0
   43                $D780.95       0.1       0.1       0.1
   44                *     99
```

PLATE A-1
Sheet 1 of 11

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**********************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  3 AUG 78
**********************************

RUN  DATE= 01/24/79.
     TIME= 11.45.09.
```

PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

RUNOFF HYDROGRAPH AT	1
ROUTE HYDROGRAPH TO	2
RUNOFF HYDROGRAPH AT	3
COMBINE 2 HYDROGRAPHS AT	4
ROUTE HYDROGRAPH TO	5
END OF NETWORK	

```
* ********** ID = 38026 WIGGINS OZARK CAMP DAM **********************
 ********** DAM SAFETY PROGRAM - U. S. CORPS OF ENGINEERS **********
 ********** REITZ & JENS, INC. -    SEPTEMBER 1978 ******************
```

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
288	0	5	-0	-0	-0	-0	-0	-4	-0
		JOPER	NWT	LROPT	TRACE				
		5	-0	-0	-0				

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 6 LRTIO= 1

RTIOS= .02 .03 .04 .05 .50 1.00

```
**********          **********          **********          **********          **********
```

SUB-AREA RUNOFF COMPUTATION

***** INFLOW HYDROGRAPH - SCS METHOD *****

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	0	-0	-0	1	3	1	-0	-0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	2	1.05	-0.00	1.05	1.00	-0.000	-0	1	-0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
-0.00	26.60	101.00	120.00	130.00	-0.00	-0.00	-0.00

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
-0	-0.00	-0.00	1.00	-0.00	-0.00	1.00	-1.00	-88.00	-0.00	.02

CURVE NO = -88.00 WETNESS = -1.00 EFFECT CN = 88.00

UNIT HYDROGRAPH DATA
TC= -0.00 LAG= .40

RECESSION DATA
STRTQ= -0.00 QRCSN= -.20 RTIOR= 2.00

UNIT HYDROGRAPH 26 END OF PERIOD ORDINATES, TC= -0.00 HOURS, LAG= .40 VOL= 1.00

186.	326.	685.	1013.	1144.	1117.	971.	770.	532.	389.
291.	216.	157.	116.	85.	62.	46.	34.	25.	18.
14.	11.	8.	5.	3.	1.				

END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q

PLATE A-1
Sheet 2 of 11

HYDROGRAPH ROUTING

***** RESERVOIR ROUTING - SPILLWAY AND DAM EQUATIONS ******

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
2	1	-0	-0	1	2	1	-0	-0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
-0.0	-0.000	-0.00	1	1	-0	-0	-0

NSTPS	NSTOL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	-0	-0	-0.000	-0.000	-0.000	-795.	-0

SURFACE AREA=	0.	5.	9.	31.
CAPACITY=	0.	25.	60.	438.
ELEVATION=	780.	795.	800.	820.

CREL	SPWID	COQW	EXPW	ELEVL	COOL	CAREA	EXPL
795.0	15.0	3.2	1.5	-0.0	-0.0	-0.0	-0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
797.5	3.0	1.5	500.

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

***** SUB-AREA DIRECTLY TRIBUTARY TO WIGGINS DAM *****

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
3	0	-0	-0	1	3	1	-0	-0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	2	.39	-0.00	.39	1.00	-0.000	-0	1	-0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
-0.00	26.60	101.00	120.00	130.00	-0.00	-0.00	-0.00

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
-0	-0.00	-0.00	1.00	-0.00	-0.00	1.00	-1.00	-85.00	-0.00	.08

CURVE NO = -85.00 WETNESS = -1.00 EFFECT CN = 85.00

UNIT HYDROGRAPH DATA

TC= -0.00 LAG= .20

RECESSION DATA

STRTQ= -0.00 QRCSN= -.10 RTIOR= 2.00

UNIT HYDROGRAPH 14 END OF PERIOD ORDINATES, TC= -0.00 HOURS, LAG= .20 VOL= 1.00

189.	623.	773.	618.	344.	198.	112.	65.	37.	21.
12.	7.	4.	1.						

END-OF-PERIOD FLOW

0 MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q

PLATE A-1
Sheet 3 of 11

SUM OF 2 HYDROGRAPHS AT 4 PLAN 1 RTIO 1

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	2.	2.	3.	3.	3.	4.
4.	4.	4.	5.	5.	5.	5.	6.	6.	6.
7.	7.	7.	7.	7.	8.	8.	8.	8.	9.
9.	9.	9.	10.	10.	10.	10.	10.	11.	11.
11.	11.	11.	11.	12.	12.	12.	12.	12.	12.
12.	13.	13.	13.	13.	13.	13.	13.	13.	13.
13.	13.	14.	14.	14.	14.	14.	14.	14.	14.
14.	14.	14.	14.	15.	17.	19.	21.	23.	24.
25.	26.	27.	29.	30.	31.	32.	34.	35.	37.
38.	40.	41.	42.	43.	44.	45.	46.	47.	49.
51.	53.	54.	56.	57.	58.	59.	60.	61.	62.
63.	63.	64.	67.	72.	82.	106.	136.	150.	148.
140.	136.	133.	132.	130.	128.	125.	123.	120.	116.
113.	110.	107.	104.	101.	97.	94.	90.	88.	85.
83.	80.	78.	76.	75.	73.	71.	66.	62.	60.
58.	56.	54.	51.	49.	47.	45.	43.	41.	40.
38.	36.	34.	33.	31.	30.	29.	27.	26.	25.
24.	23.	22.	21.	20.	19.	18.	17.	16.	16.
15.	15.	14.	14.	13.	13.	12.	12.	11.	11.
11.	10.	10.	10.	10.	9.	9.	9.	9.	9.
8.	8.	8.	8.	8.	8.	7.	7.	7.	7.
7.	7.	7.	7.	7.	7.	7.	6.		

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	150.	77.	26.	26.	7425.
CMS	4.	2.	1.	1.	210.
INCHES		.49	.67	.67	.67
MM		12.56	16.92	16.92	16.92
AC-FT		38.	51.	51.	51.
THOUS CU M		47.	63.	63.	63.

PLATE A-1
Sheet 4 of 11

2% PMF

SUM OF 2 HYDROGRAPHS AT 4 PLAN 1 RATIO 2

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	2.	2.	3.	4.	4.	5.	5.	6.
6.	6.	7.	7.	8.	8.	9.	9.	9.	10.
10.	11.	11.	12.	12.	12.	13.	13.	14.	14.
14.	15.	15.	15.	16.	16.	16.	17.	17.	17.
17.	18.	18.	18.	18.	19.	19.	19.	19.	19.
19.	19.	20.	20.	20.	20.	20.	20.	20.	21.
21.	21.	21.	21.	21.	21.	21.	21.	21.	21.
21.	22.	22.	22.	23.	25.	29.	32.	35.	37.
38.	40.	42.	44.	46.	47.	49.	52.	55.	57.
59.	61.	63.	65.	67.	68.	70.	71.	73.	74.
79.	81.	83.	85.	87.	89.	91.	92.	94.	95.
96.	96.	98.	102.	110.	125.	161.	206.	228.	226.
215.	209.	206.	203.	201.	197.	193.	188.	183.	177.
172.	166.	161.	156.	151.	146.	140.	135.	130.	126.
123.	119.	116.	113.	110.	108.	104.	98.	92.	88.
85.	82.	78.	75.	72.	69.	66.	63.	60.	57.
54.	52.	49.	47.	45.	43.	41.	39.	37.	35.
33.	32.	30.	29.	27.	26.	25.	24.	23.	22.
21.	20.	19.	19.	18.	17.	17.	16.	16.	15.
15.	14.	14.	13.	13.	13.	12.	12.	12.	12.
11.	11.	11.	11.	11.	11.	10.	10.	10.	10.
10.	10.	10.	9.	9.	9.	9.	9.		

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	228.	116.	39.	39.	11181.
CMS	6.	3.	1.	1.	317.
INCHES		.75	1.00	1.00	1.00
MM		19.01	25.48	25.48	25.48
AC-FT		57.	77.	77.	77.
THOUS CU M		71.	95.	95.	95.

3% PMF

PLATE A-1
Sheet 5 of 11

SUM OF 2 HYDROGRAPHS AT 4 PLAN 1 RTIO 3

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
2.	2.	2.	3.	4.	5.	6.	7.	7.	8.
9.	9.	9.	10.	11.	11.	12.	13.	13.	14.
14.	15.	16.	16.	17.	17.	18.	18.	19.	19.
20.	20.	21.	21.	22.	22.	22.	23.	23.	23.
24.	24.	24.	25.	25.	25.	25.	26.	26.	26.
26.	26.	27.	27.	27.	27.	27.	27.	28.	28.
28.	28.	28.	28.	28.	28.	29.	29.	29.	29.
29.	29.	29.	29.	30.	34.	39.	43.	46.	49.
52.	54.	57.	59.	62.	64.	67.	71.	74.	78.
81.	83.	86.	88.	91.	93.	95.	97.	99.	103.
106.	110.	113.	115.	118.	120.	122.	125.	127.	129.
129.	129.	132.	137.	148.	168.	216.	276.	307.	304.
291.	283.	314.	343.	326.	294.	264.	241.	228.	222.
216.	210.	204.	198.	192.	186.	179.	173.	167.	162.
158.	153.	149.	146.	142.	139.	135.	127.	119.	115.
110.	106.	101.	97.	93.	89.	85.	81.	77.	73.
70.	67.	63.	60.	57.	55.	52.	49.	47.	45.
42.	40.	38.	36.	35.	33.	31.	30.	29.	27.
26.	25.	24.	23.	22.	21.	21.	20.	19.	19.
18.	18.	17.	17.	16.	16.	16.	15.	15.	15.
14.	14.	14.	14.	13.	13.	13.	13.	13.	13.
12.	12.	12.	12.	12.	12.	12.	12.		

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	343.	155.	52.	52.	14940.
CMS	10.	4.	1.	1.	423.
INCHES		1.00	1.34	1.34	1.34
MM		25.49	34.05	34.05	34.05
AC-FT		77.	103.	103.	103.
THOUS CU M		95.	127.	127.	127.

4% PMF

PLATE A-1
Sheet 6 of 11

SUM OF 2 HYDROGRAPHS AT 4 PLAN 1 RTIO 4

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	2.	2.	2.	2.	2.	2.
2.	2.	2.	2.	2.	2.	2.	2.	3.	3.
3.	3.	3.	4.	5.	7.	8.	8.	9.	10.
11.	11.	12.	13.	14.	15.	15.	16.	17.	18.
19.	19.	20.	21.	22.	22.	23.	24.	24.	25.
26.	26.	27.	27.	28.	28.	29.	29.	30.	30.
30.	31.	31.	31.	32.	32.	32.	33.	33.	33.
33.	34.	34.	34.	34.	34.	34.	35.	35.	35.
35.	35.	35.	36.	36.	36.	36.	36.	36.	36.
36.	36.	36.	37.	38.	43.	44.	54.	58.	62.
65.	69.	72.	75.	79.	82.	85.	90.	94.	99.
102.	106.	109.	112.	115.	118.	120.	123.	126.	130.
135.	139.	142.	146.	149.	152.	154.	157.	160.	162.
163.	163.	165.	173.	186.	211.	271.	347.	385.	383.
431.	515.	514.	474.	418.	365.	323.	290.	265.	247.
237.	233.	228.	224.	219.	213.	206.	200.	195.	190.
186.	181.	177.	173.	170.	167.	162.	152.	143.	138.
133.	128.	123.	117.	112.	107.	103.	98.	93.	89.
85.	81.	77.	73.	69.	66.	63.	59.	56.	54.
51.	48.	46.	44.	41.	39.	38.	36.	34.	33.
31.	30.	29.	28.	27.	26.	25.	24.	23.	22.
22.	21.	21.	20.	20.	19.	19.	18.	18.	18.
17.	17.	17.	16.	16.	16.	16.	16.	15.	15.
15.	15.	15.	15.	14.	14.	14.	14.		

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	515.	195.	65.	65.	18696.
CMS	15.	6.	2.	2.	529.
INCHES		1.26	1.68	1.68	1.68
MM		31.98	42.61	42.61	42.61
AC-FT		97.	129.	129.	129.
THOUS CU M		119.	159.	159.	159.

5% PMF

PLATE A-1
Sheet 7 of 11

SUM OF 2 HYDROGRAPHS AT 4 PLAN 1 RTIO 5

0.	0.	1.	1.	2.	2.	2.	2.	2.	2.
2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
2.	2.	2.	2.	2.	2.	2.	3.	3.	4.
4.	5.	5.	6.	6.	7.	8.	8.	9.	10.
11.	11.	12.	13.	14.	15.	16.	17.	18.	19.
19.	20.	21.	22.	23.	24.	25.	26.	27.	28.
29.	30.	30.	31.	32.	33.	34.	35.	35.	36.
37.	38.	41.	52.	64.	79.	90.	101.	111.	123.
134.	146.	158.	169.	181.	192.	203.	213.	223.	232.
241.	249.	257.	264.	271.	280.	300.	314.	323.	329.
333.	336.	338.	340.	342.	344.	346.	347.	349.	350.
351.	352.	354.	355.	356.	357.	358.	359.	360.	360.
361.	362.	363.	364.	364.	365.	366.	366.	367.	367.
368.	369.	369.	370.	370.	371.	371.	371.	372.	372.
373.	373.	373.	374.	390.	447.	534.	635.	739.	842.
935.	1011.	1066.	1107.	1136.	1159.	1180.	1210.	1247.	1286.
1322.	1356.	1385.	1409.	1427.	1440.	1450.	1458.	1471.	1503.
1548.	1598.	1647.	1694.	1734.	1767.	1791.	1809.	1821.	1831.
1823.	1798.	1803.	1864.	2019.	2374.	3216.	4423.	5403.	5902.
5936.	5683.	5213.	4603.	3964.	3414.	2997.	2675.	2428.	2244.
2109.	2012.	1941.	1888.	1842.	1786.	1723.	1660.	1601.	1548.
1502.	1464.	1436.	1417.	1404.	1394.	1361.	1264.	1151.	1068.
998.	933.	871.	814.	760.	710.	663.	620.	579.	541.
506.	473.	442.	414.	387.	362.	339.	318.	298.	280.
263.	248.	234.	227.	220.	213.	207.	202.	196.	191.
184.	178.	172.	167.	163.	159.	155.	152.	149.	147.
144.	142.	141.	139.	137.	136.	135.	134.	133.	132.
131.	130.	130.	129.	128.	128.	127.	127.	127.	126.
126.	126.	126.	125.	125.	125.	125.	125.		

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	5936.	2029.	655.	655.	188545.
CMS	168.	57.	19.	19.	5339.
INCHES		13.10	14.92	14.92	14.92
MM		332.83	429.68	429.68	429.68
AC-FT		1006.	1299.	1299.	1299.
THOUS CU M		1241.	1602.	1602.	1602.

50% PMF

PLATE A-1
Sheet 8 of 11

SUM OF 2 HYDROGRAPHS AT 4 PLAN 1 RTIO 6

0.	1.	2.	3.	3.	3.	3.	3.	4.	4.
4.	4.	4.	4.	4.	4.	4.	4.	4.	4.
4.	4.	4.	4.	4.	5.	5.	6.	7.	8.
9.	10.	11.	12.	14.	15.	17.	18.	20.	22.
24.	25.	27.	29.	31.	33.	35.	37.	39.	41.
43.	45.	47.	49.	51.	53.	55.	57.	59.	60.
62.	64.	65.	67.	69.	70.	72.	73.	75.	76.
78.	79.	86.	108.	136.	163.	187.	209.	232.	257.
281.	307.	332.	424.	509.	548.	568.	582.	594.	604.
612.	621.	628.	635.	641.	647.	653.	658.	663.	667.
672.	676.	679.	683.	686.	689.	693.	695.	698.	701.
703.	706.	708.	710.	712.	714.	716.	718.	720.	722.
723.	725.	726.	728.	729.	731.	732.	733.	734.	735.
736.	737.	738.	739.	740.	741.	742.	743.	744.	745.
746.	746.	747.	748.	782.	901.	1085.	1299.	1513.	1718.
1898.	2043.	2150.	2225.	2281.	2323.	2365.	2425.	2499.	2578.
2651.	2719.	2777.	2823.	2858.	2883.	2902.	2917.	2944.	3008.
3100.	3204.	3303.	3396.	3475.	3540.	3587.	3620.	3645.	3664.
3646.	3595.	3605.	3729.	4246.	4771.	6483.	8928.	10698.	11877.
11909.	11369.	10403.	9165.	7876.	6774.	5952.	5314.	4826.	4452.
4198.	4007.	3869.	3767.	3677.	3565.	3439.	3311.	3193.	3084.
2994.	2920.	2866.	2830.	2805.	2796.	2719.	2521.	2286.	2121.
1980.	1848.	1726.	1611.	1504.	1406.	1313.	1226.	1145.	1069.
999.	933.	871.	814.	760.	710.	663.	620.	579.	541.
506.	473.	442.	414.	387.	362.	342.	325.	309.	295.
282.	270.	262.	258.	256.	255.	254.	254.	253.	253.
252.	252.	251.	251.	250.	250.	250.	249.	249.	249.
249.	249.	248.	248.	248.	248.	248.	248.	248.	248.
247.	247.	247.	247.	247.	247.	247.	247.		

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	11909.	4058.	1311.	1311.	377499.
CMS	337.	115.	37.	37.	10690.
INCHES		26.21	33.87	33.87	33.87
MM		665.80	860.29	860.29	860.29
AC-FT		2012.	2600.	2600.	2600.
THOUS CU M		2482.	3207.	3207.	3207.

100% PMF

PLATE A-1
Sheet 9 of 11

HYDROGRAPH ROUTING

***** RESERVOIR ROUTING - RATING CURVE SUPPLIED - SLOPING D

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
5	1	-0	-0	1	2	1	-0	-0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP		ISTR
-0.0	-0.000	-0.00	1	1	-0	-0		-0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	-0	-0	-0.000	-0.000	-0.000	-779.	-1

STAGE	779.0	779.2	779.5	780.0	780.6	780.8	781.0	781.0	781.2	781.5
	781.8	782.0	782.5	783.0	783.7	784.2	784.5	785.0	786.5	787.5
FLOW	0.	3.	9.	27.	56.	66.	79.	83.	103.	150.
	216.	278.	480.	753.	1323.	2026.	2675.	4010.	8938.	12230.
SURFACE AREA=	0.	16.	17.	53.						
CAPACITY=	0.	127.	144.	817.						
ELEVATION=	755.	779.	780.	800.						

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
779.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
781.0	.1	.1	0.

UPSTREAM DAM

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	795.00	795.00	797.50
STORAGE	25.	25.	40.
OUTFLOW	0.	0.	190.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.02	796.68	0.00	34.	105.	0.00	16.33	0.00
.03	797.25	0.00	38.	162.	0.00	16.33	0.00
.04	797.64	.14	41.	280.	.50	16.17	0.00
.05	797.76	.26	42.	417.	.83	16.08	0.00
.50	799.42	1.92	54.	4450.	12.33	16.00	0.00
1.00	800.62	3.12	65.	8904.	14.25	16.00	0.00

WIGGINS OZARK CAMP DAM

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	779.00	779.00	780.95
STORAGE	127.	127.	161.
OUTFLOW	0.	0.	79.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.02	780.62	0.00	155.	57.	0.00	18.42	0.00
.03	781.20	.25	166.	104.	3.42	18.08	0.00
.04	781.59	.64	173.	170.	4.92	17.42	0.00
.05	781.92	.97	180.	252.	5.75	16.67	0.00
.50	785.52	4.57	261.	5730.	15.75	16.00	0.00
1.00	787.26	6.31	307.	11456.	16.83	16.00	0.00

,13

86

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ENGINEERING GEOLOGIC REPORT OF THE WIGGINS OZARK CAMP LAKE

REYNOLDS COUNTY, MISSOURI

LOCATION: Just upstream of the center of Sec. 6, T. 32 N., R. 2 E., Lesterville Quadrangle.

The lake system serving the Ozark Camp is composed of several small lakes downstream of a large dam near the center of Sec. 6. The two small lakes are full flow concrete type structures built in a shut-in area of Adams Hollow. The large lake, constructed several years ago, is about 33 feet high from the lowest point of the valley.

A large slide has developed on the downstream face of the dam at its highest point near the old stream channel. This slide has progressed almost all the way through the crown of the dam and has dropped a considerable distance vertically. The slide does not appear to be fresh in that it probably occurred several months to perhaps as much as a year ago. No water movement through the slide material was noted. Conversation with the landowner indicates that the water level has been kept at a low point via a pipe under the dam but the water level in the lake was approximately 2-3 feet below normal pool on the date of this investigation.

The slopes on the downstream side at the high point appear to be about a 1:1 with flatter slopes to the west in the area where the dam is at a lower height. Large quantities of water move under the core area of the dam to emerge downstream at numerous locations. One leak is present which appears to be a horizontal through bedrock around the left abutment (near the spillway). This leak in all probability did not precipitate the slide but does contribute to keeping portions of the slide area wet.

The principal spillway is approximately 10 feet wide by 4 feet in depth and is constructed of concrete. This shute spillway has some erosion problems on the downstream end where undercutting due to water flow has allowed portions of the lower end to collapse. The emergency spillway is an earthen type spillway off the left abutment just to the east of the principal spillway.

The pipe under the dam appears to be about a 24 inch pipe with a valve, running through the dam into the lake with no riser.

The drainage area serving this lake is approximately 920 surface acres with the lake at full pool estimated to be about 22 acres.

A small lake of about 4 acres is present upstream of the large lake near the tailwaters. This lake was reported to have been constructed some 30 years ago and dams the entire drainage above it. Much beaver activity in the lake and stream has caused the spillway to be dammed on numerous occasions with at least one incident of overtopping of the dam noted. The spillway on the small structure is filled in by mud and other debris from the beavers with a considerable amount of water loss through and under the concrete structures. Failure of this dam would in all probability add considerable quantities of water to the large lakes just downstream.

The large slide on the main dam structure is considered very hazardous as a full lake will cause saturation of the upper part of the dam and thus additional sliding would be expected to take place. If the slide progressed back towards the lake to where water could move through the broken slide material, disastrous collapse of that part of the dam in all probability would occur. The sudden release of water would rapidly move down the valley, probably skipping over the top of the concrete structures below, which may well result in danger to the owner's home just off the floodplain on the west side of the valley. Highway 72-49-21 is present about 3/4 mile downstream as is a barn with numerous cattle. Severe damage to the highway would be expected in case of dam failure.

It was recommended to the landowner on the date of this investigation that the first priority would be to lower the water level in the lake to where only enough water remained to maintain the fish population, i.e. 5-10 feet of water. This water level should be maintained particularly during the spring months of the year so the lake does not fill to normal pool level. The landslide, in other words, must be kept dry until it can be repaired.

Repair of the slide means removal of the failed soil material in that area. The failed area is about 60 yards wide and from the toe of the dam all the way to the top of the dam. This material must be physically removed and then replaced in lifts with adequate compaction. If at all possible, this work should be designed and completed with the advice and supervision of a qualified engineer experienced in foundation problems. In addition to replacing the soil material, an attempt should be made to decrease the steepness of the slope to prevent future slide problems. A minimum slope configuration on this area is recommended to be at least 3:1 rather than 1:1. After the slide has been repaired, a berm could be placed on the toe of the dam which would also in effect prevent further sliding.

In summary, in its present condition, the dam would be considered very hazardous if water is allowed to remain at full pool elevation. Constant surveillance is recommended to keep the water level at a very low elevation. Repair of the slide is somewhat tricky and should be done with adequate supervision. Collapse of the dam in its present condition would result in probable hazardous results downstream.

Thomas J. Dean, Geologist
Applied Engineering & Urban Geology
Geology & Land Survey
May 24, 1978

orig: Marion Wiggins
Ozark Camp
P.O. Box 180
Lesterville, MO

PLATE 4

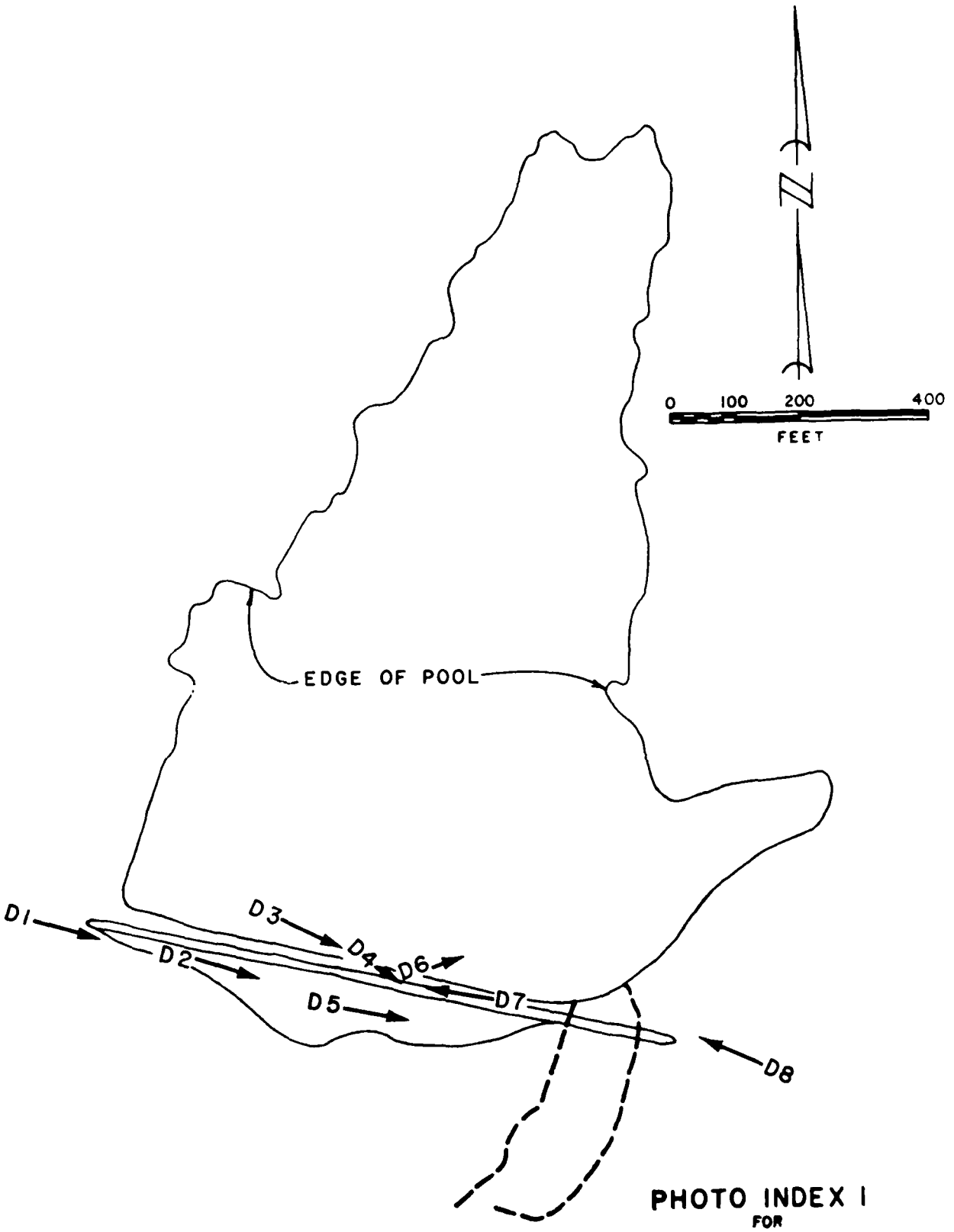
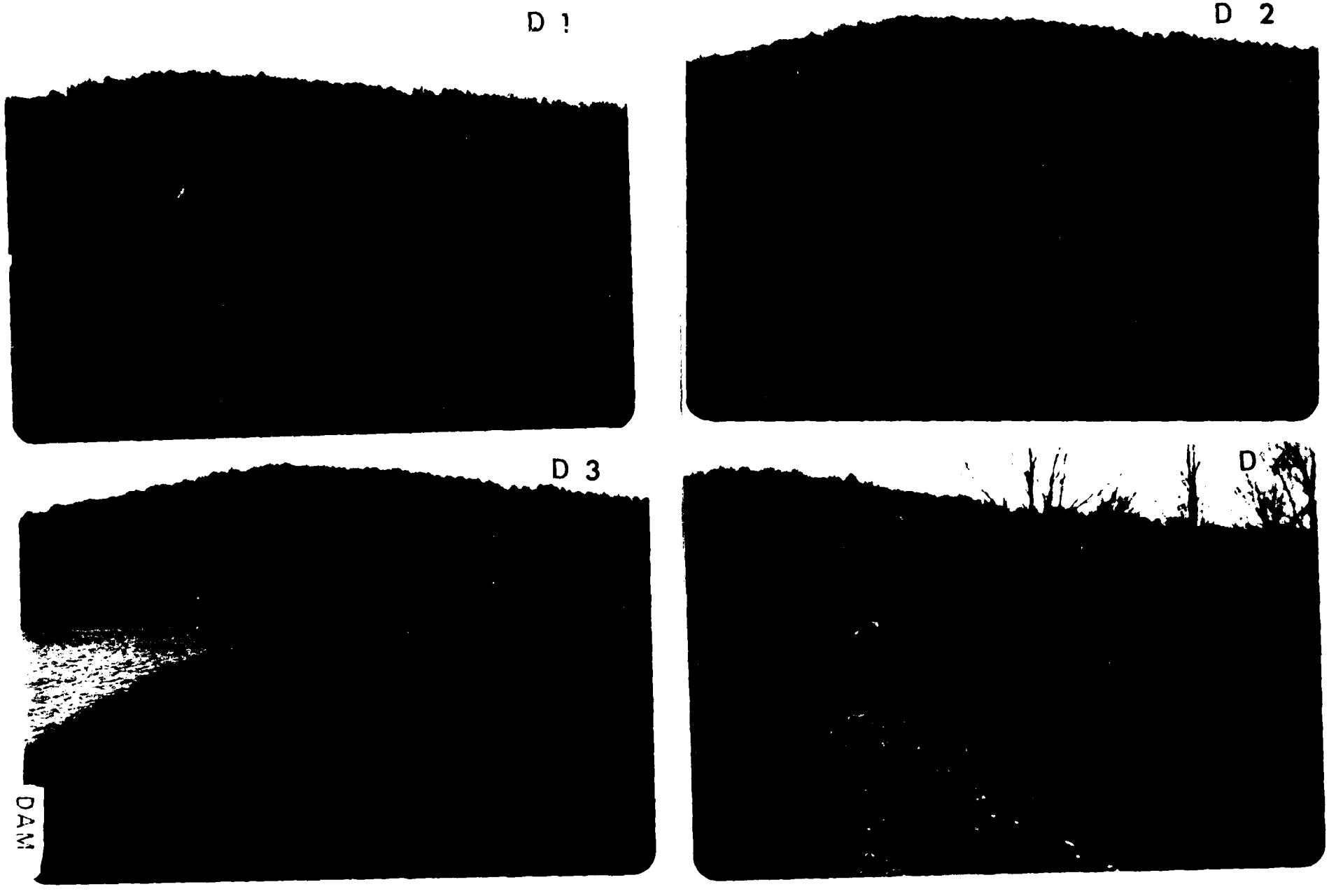


PHOTO INDEX I
FOR
DAM

WIGGINS OZARK CAMP DAM
REYNOLDS COUNTY, MO.
DECEMBER 1978

PREPARED BY
REITZ & JENS, INC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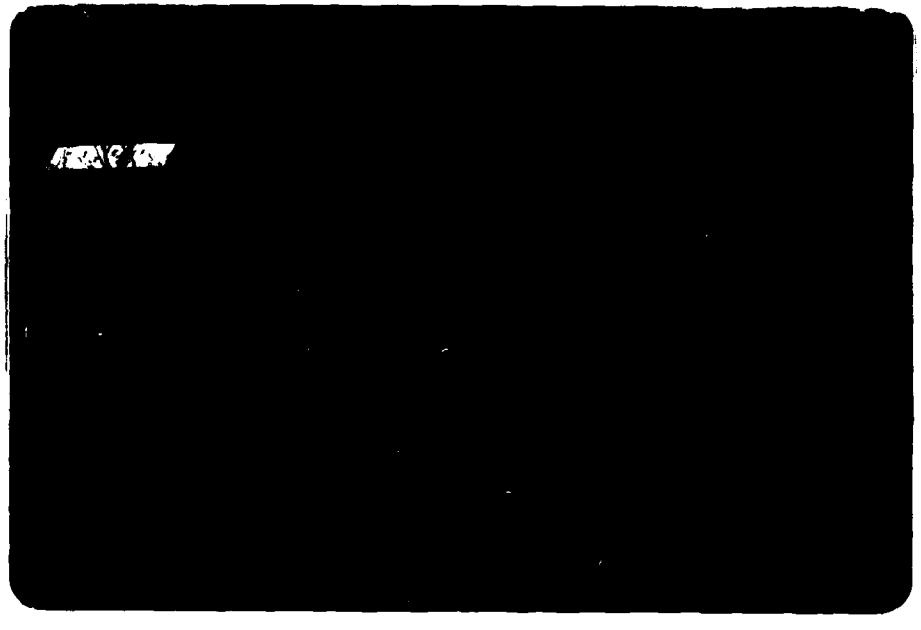
D 3
D
DAM

D 5

D 6

D 7



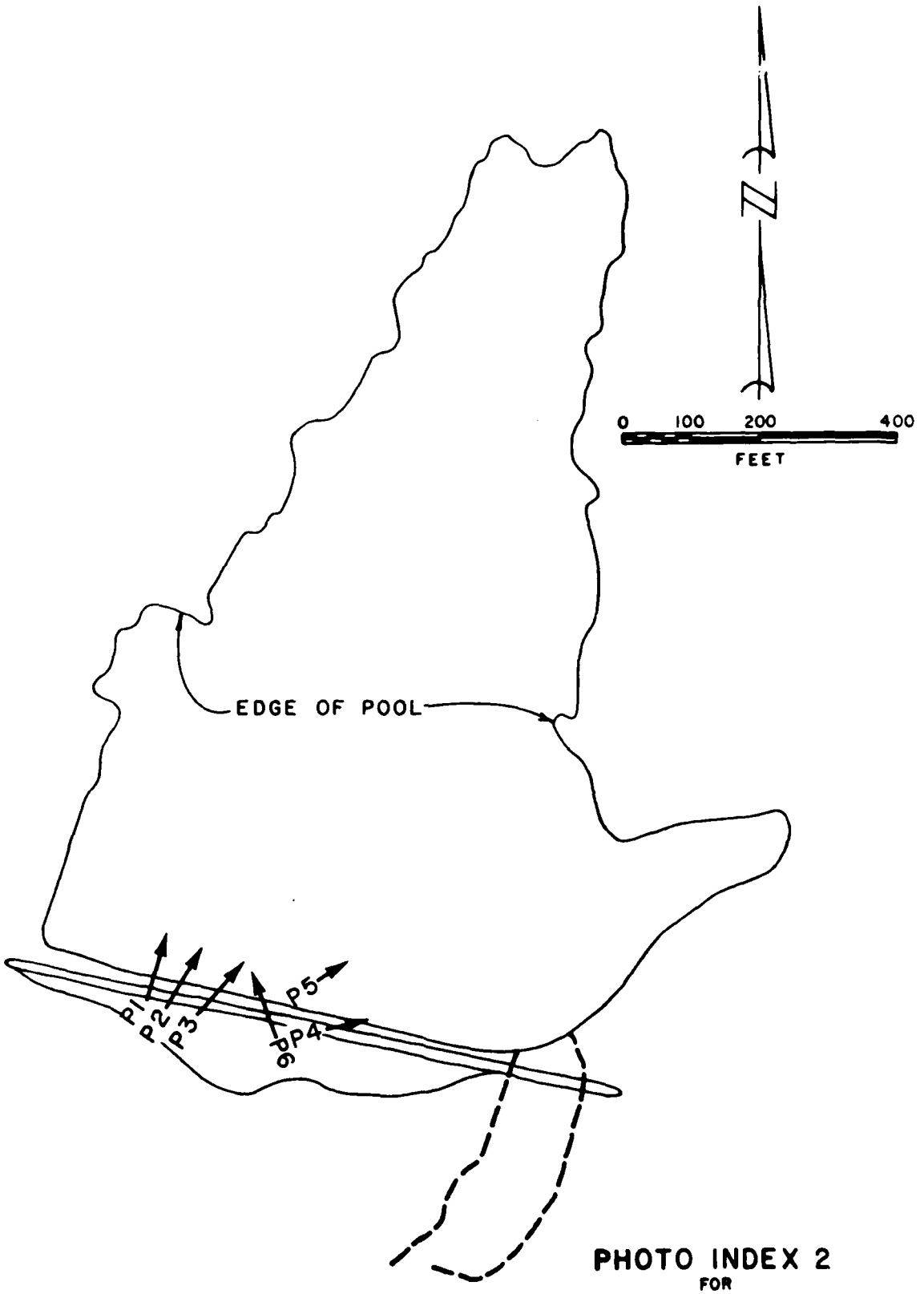
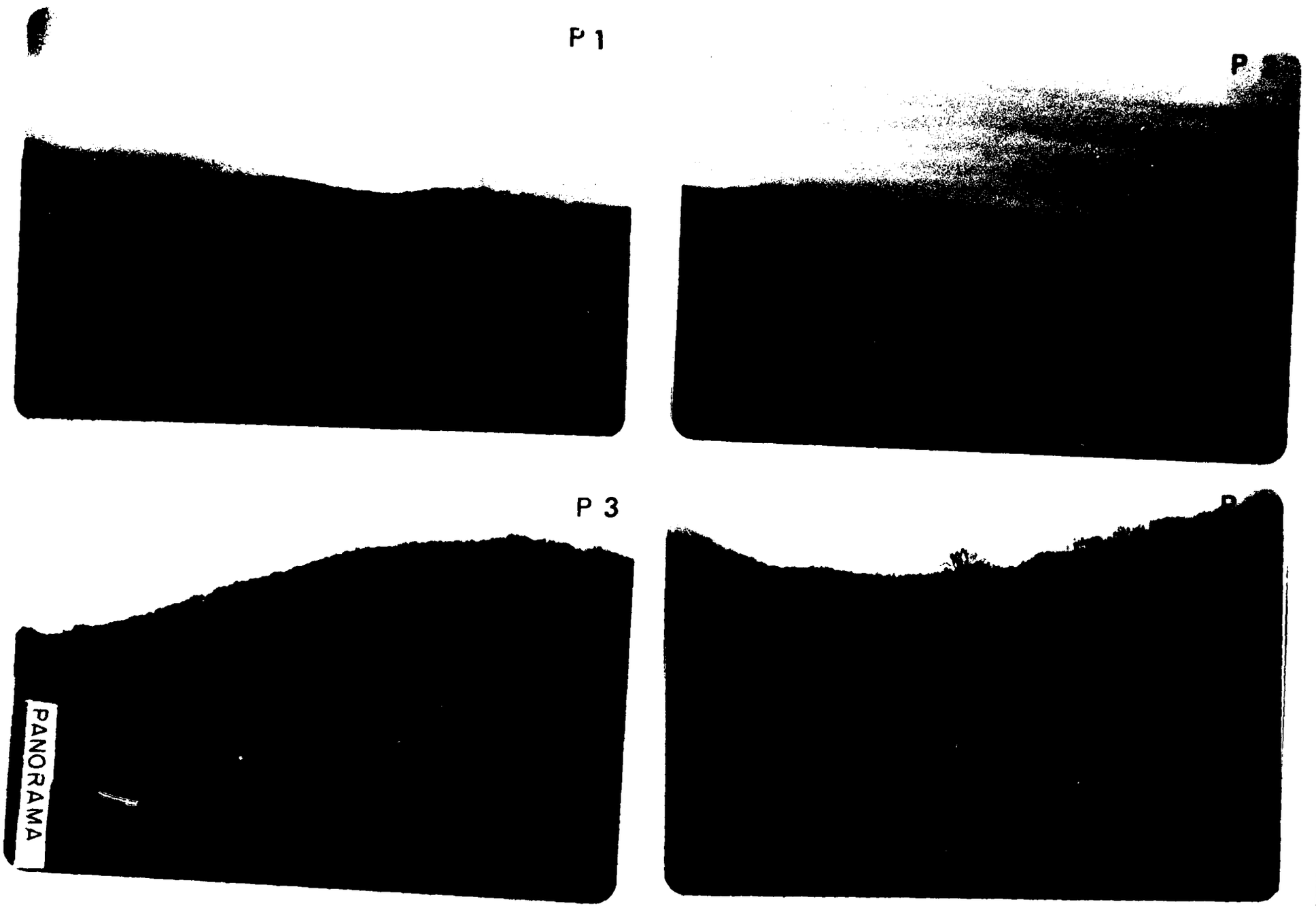


PHOTO INDEX 2
FOR
PANORAMA

WIGGINS OZARK CAMP DAM
REYNOLDS COUNTY, MO.
DECEMBER 1978

PREPARED BY
REITZ & JENS, INC.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P
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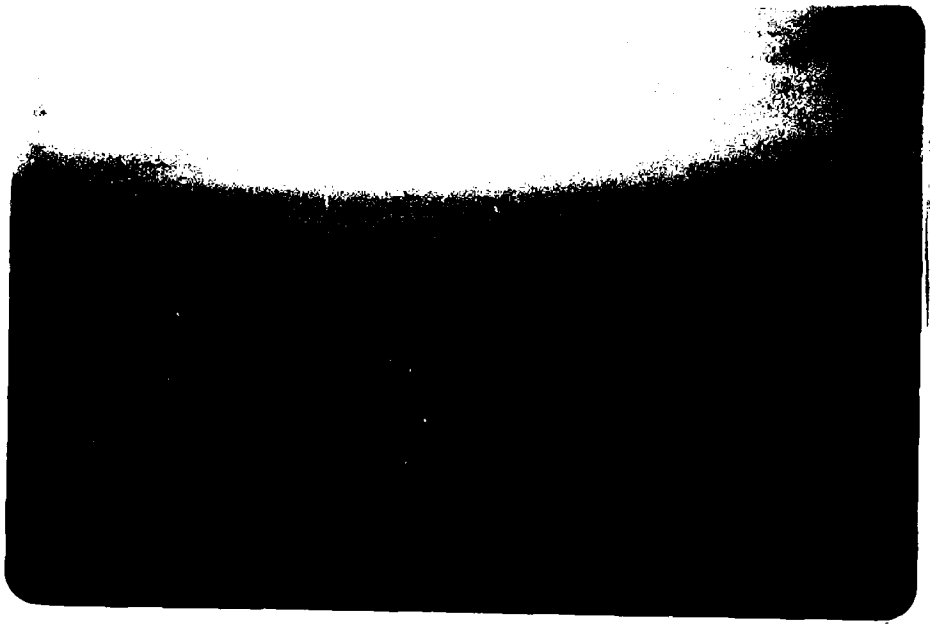
PANORAMA



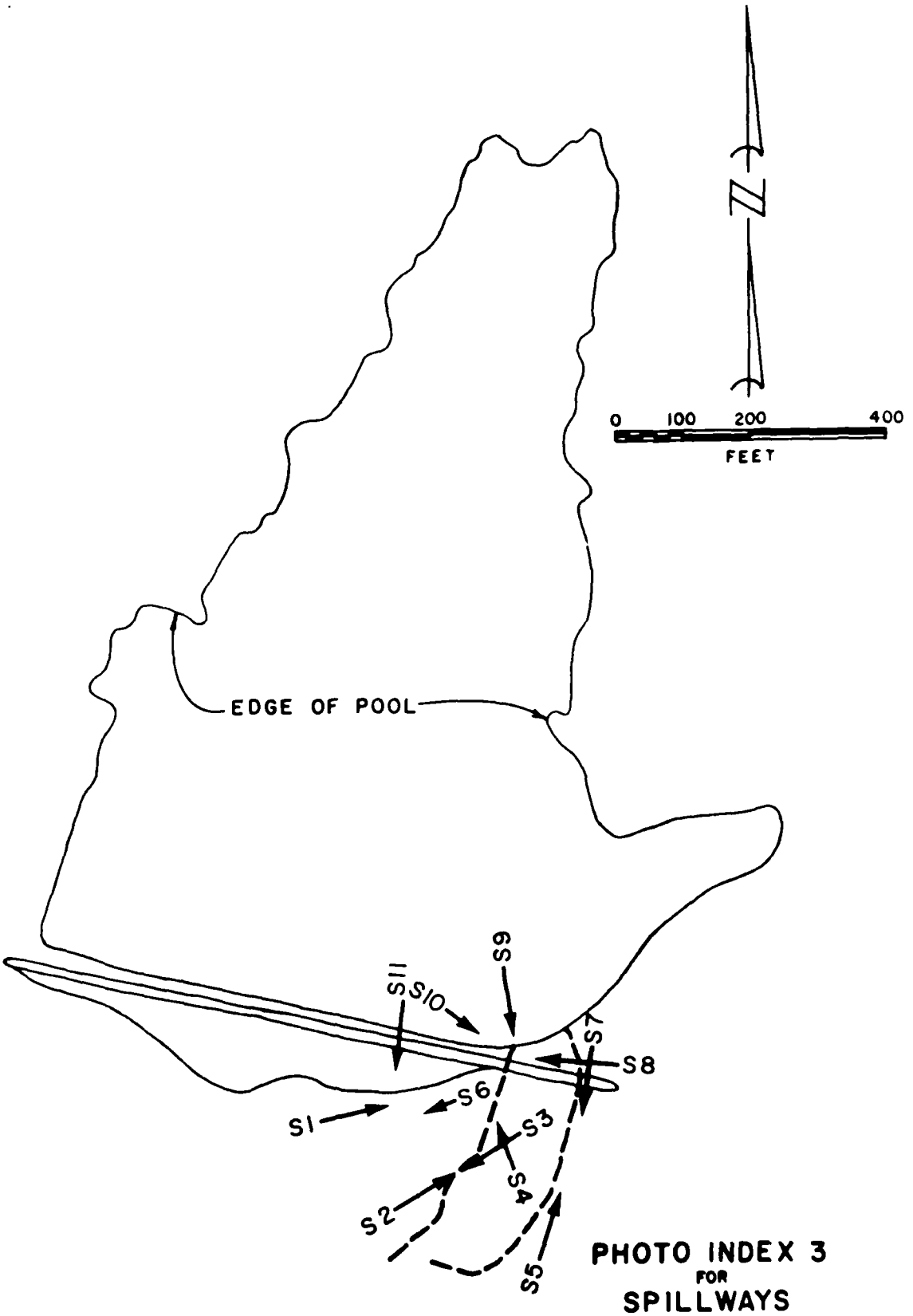


PHOTO INDEX 3
FOR
SPILLWAYS

WIGGINS OZARK CAMP DAM
REYNOLDS COUNTY, MO.
DECEMBER 1978

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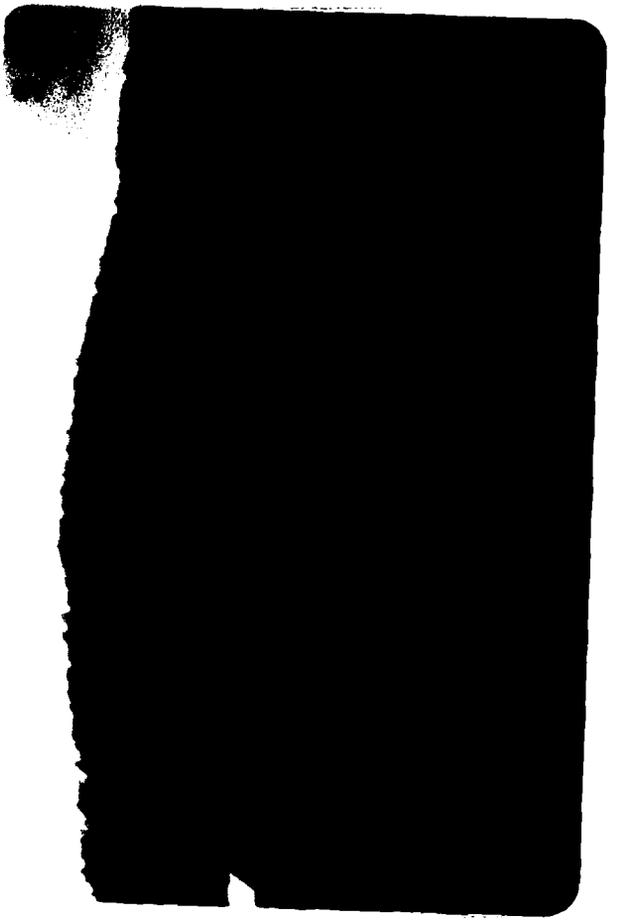
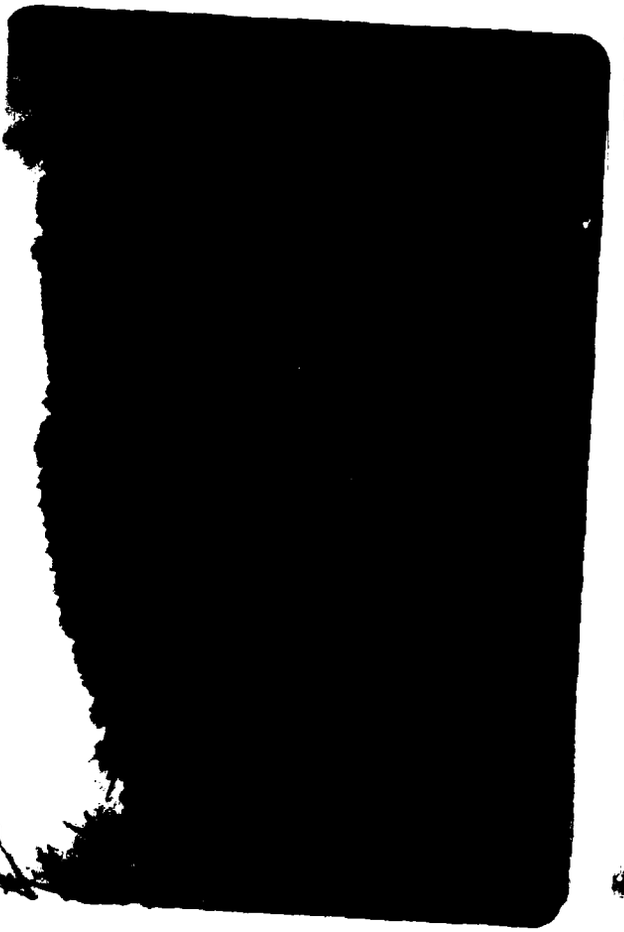
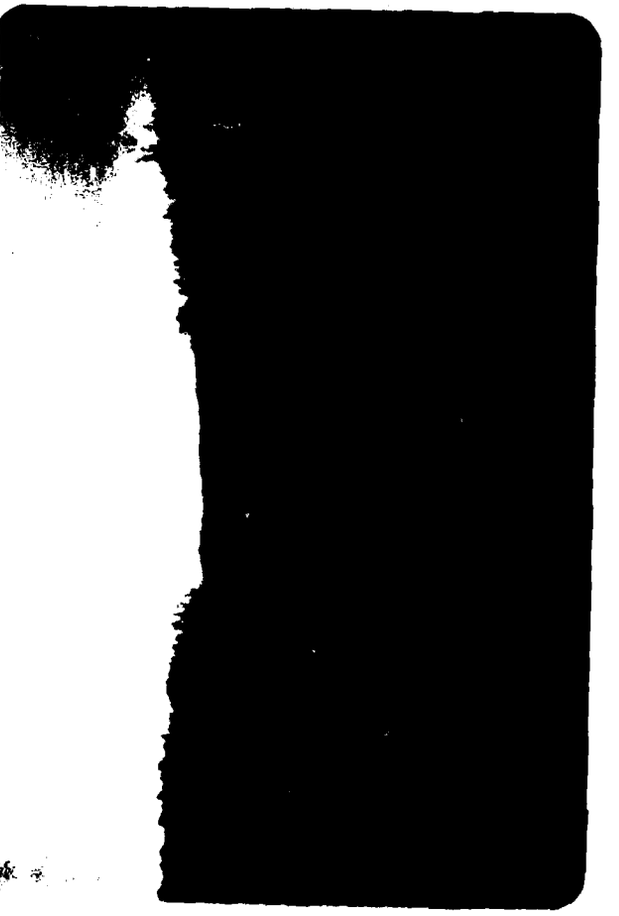
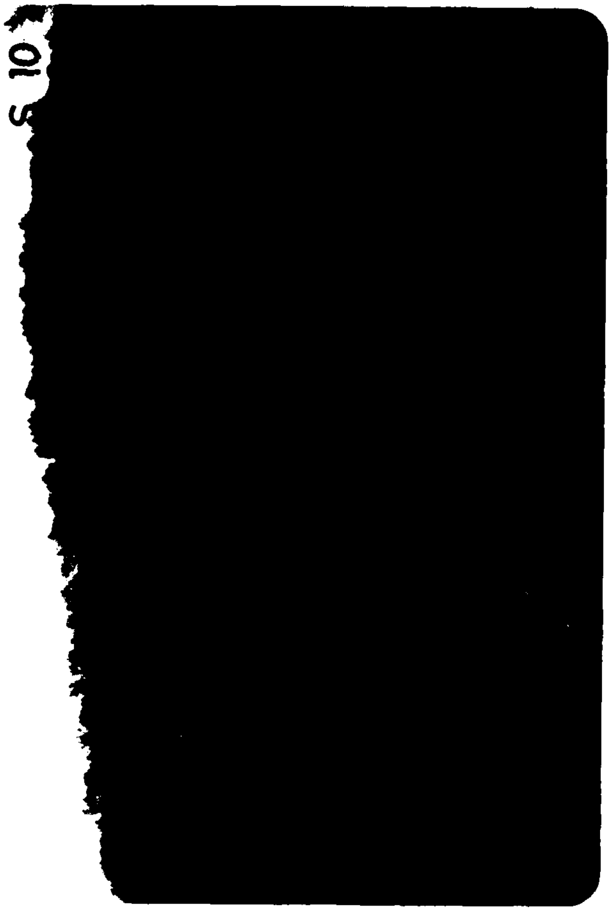
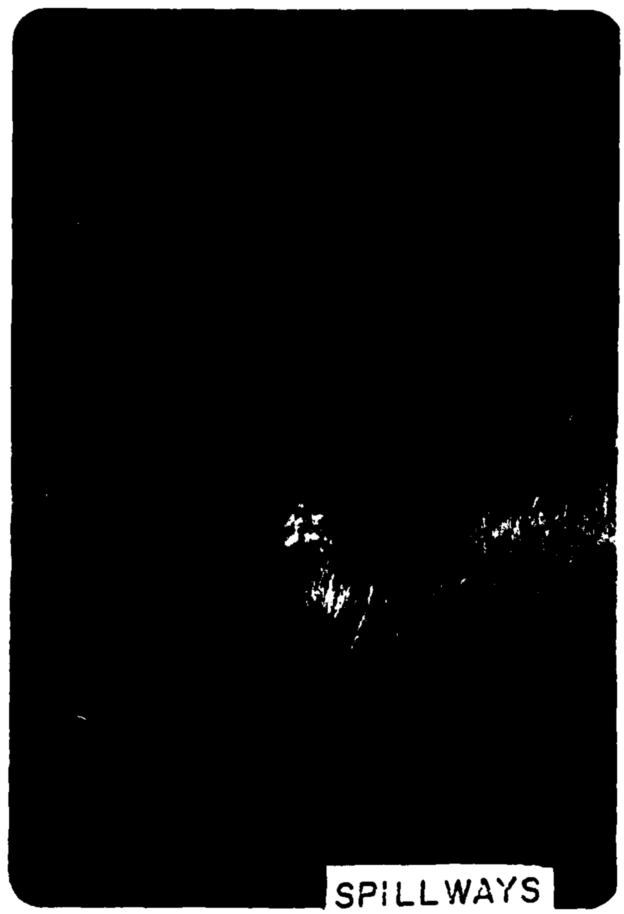
SPILLWAYS










SPILLWAYS

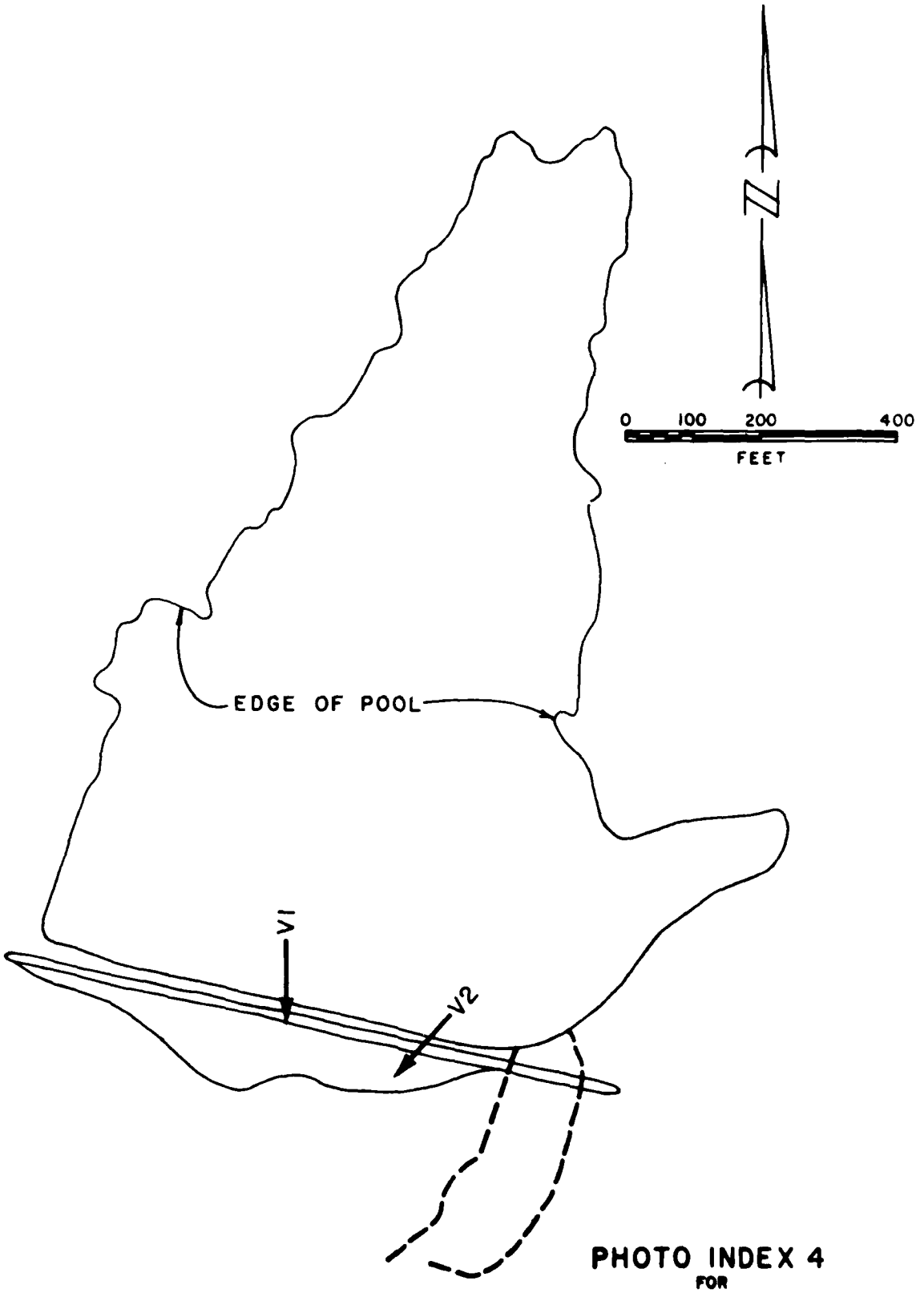
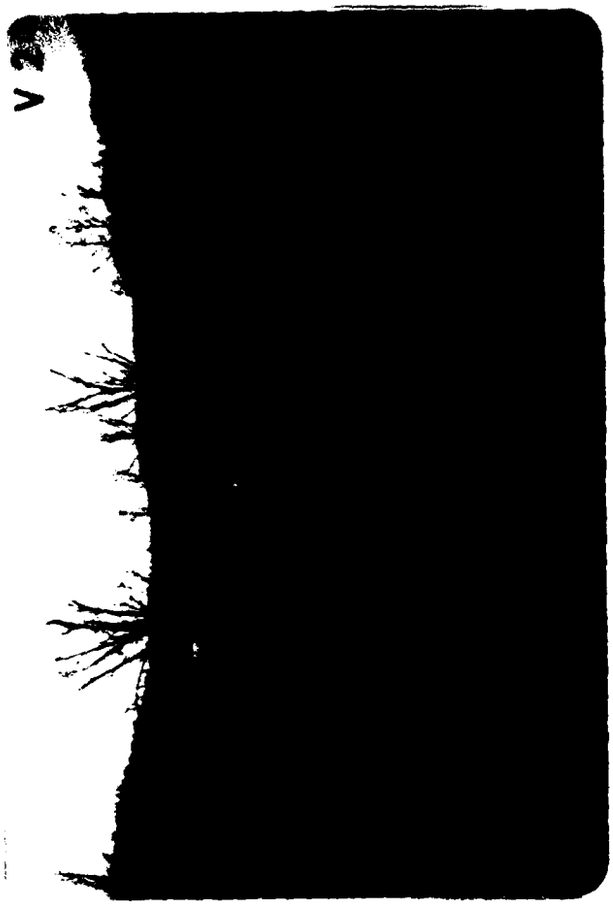
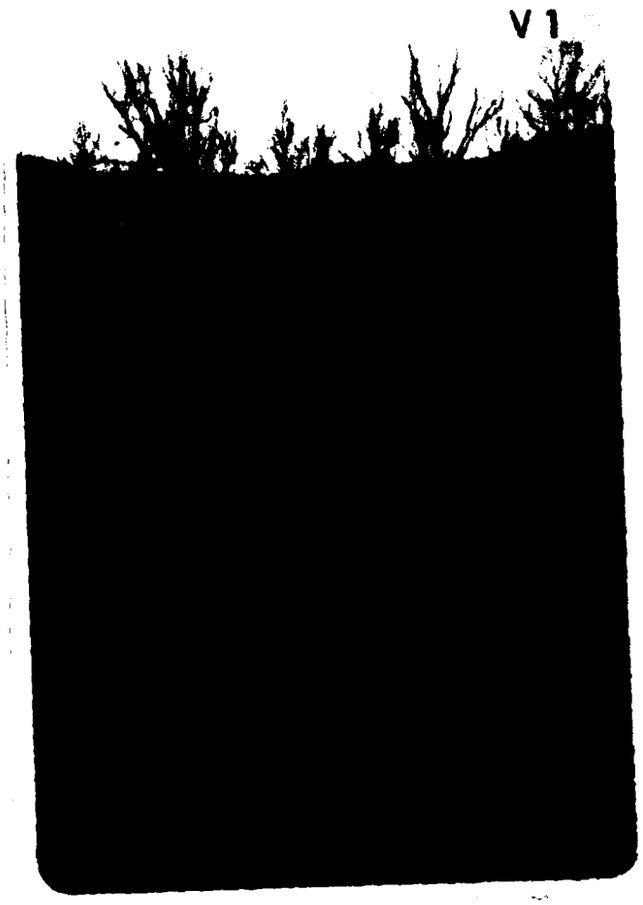


PHOTO INDEX 4
FOR
VALLEY BELOW DAM

WIGGINS OZARK CAMP DAM
REYNOLDS COUNTY, MO.
DECEMBER 1978

PREPARED BY
REITZ & JENS, INC.





VALLEY BELOW DAM

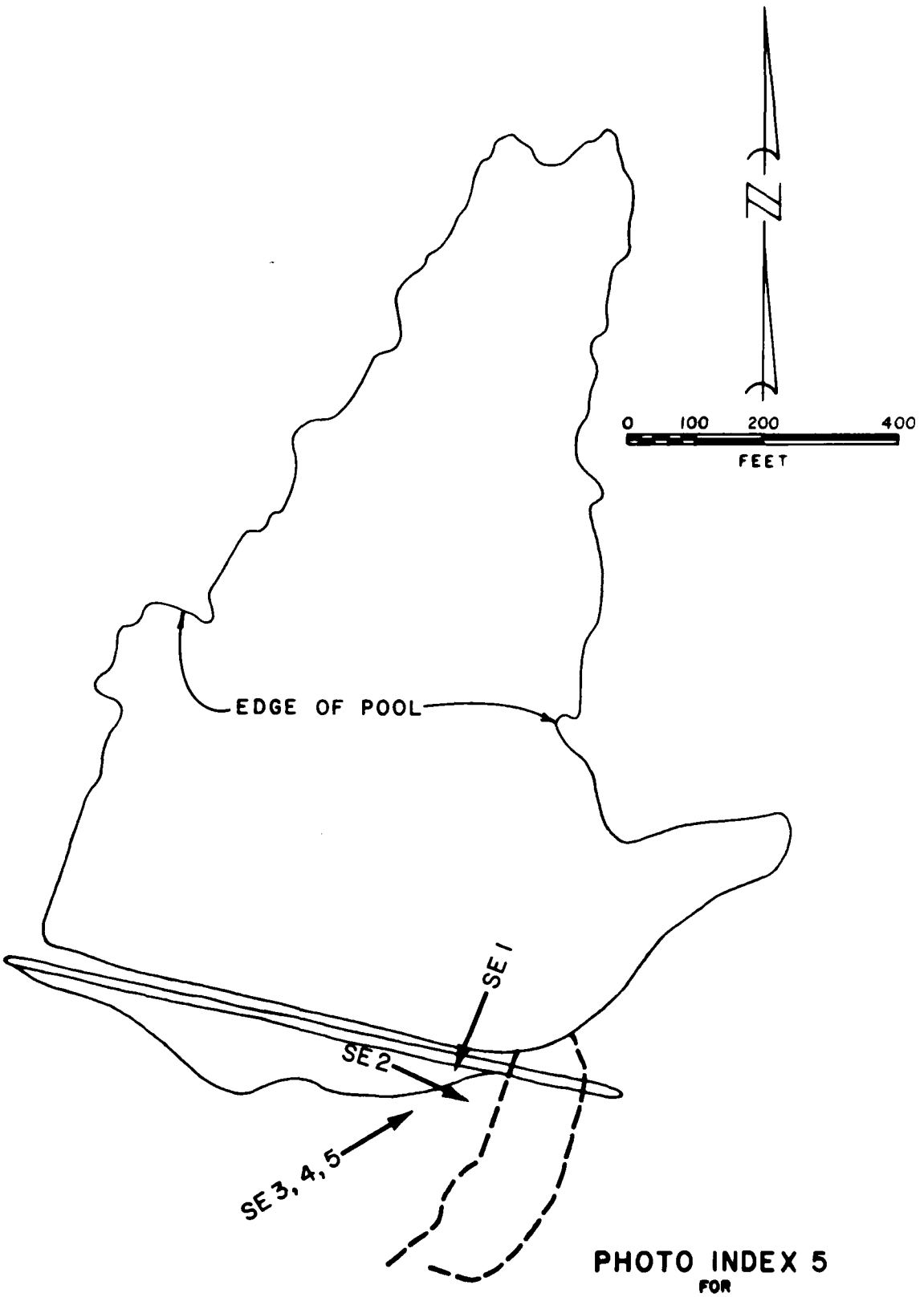
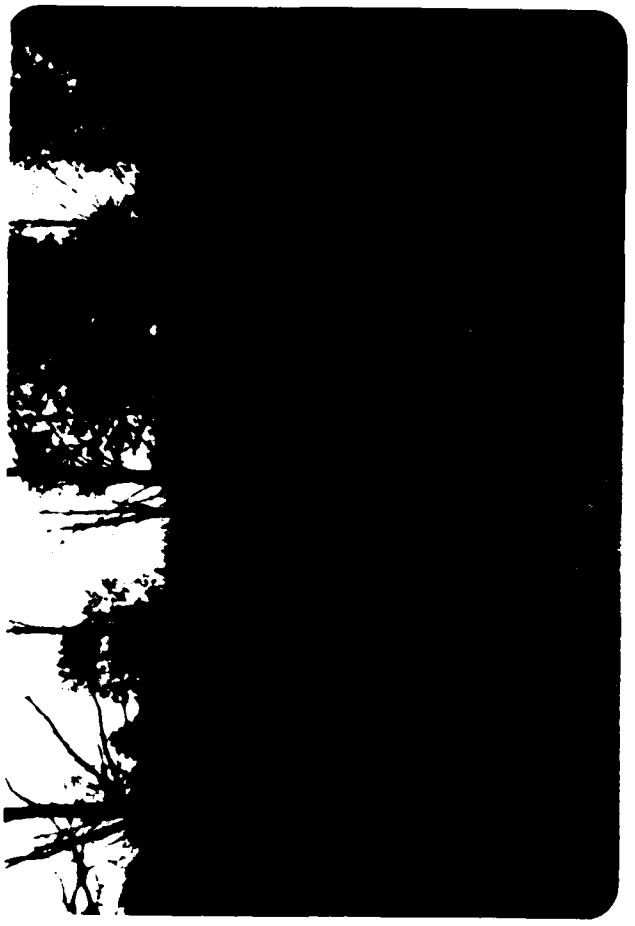
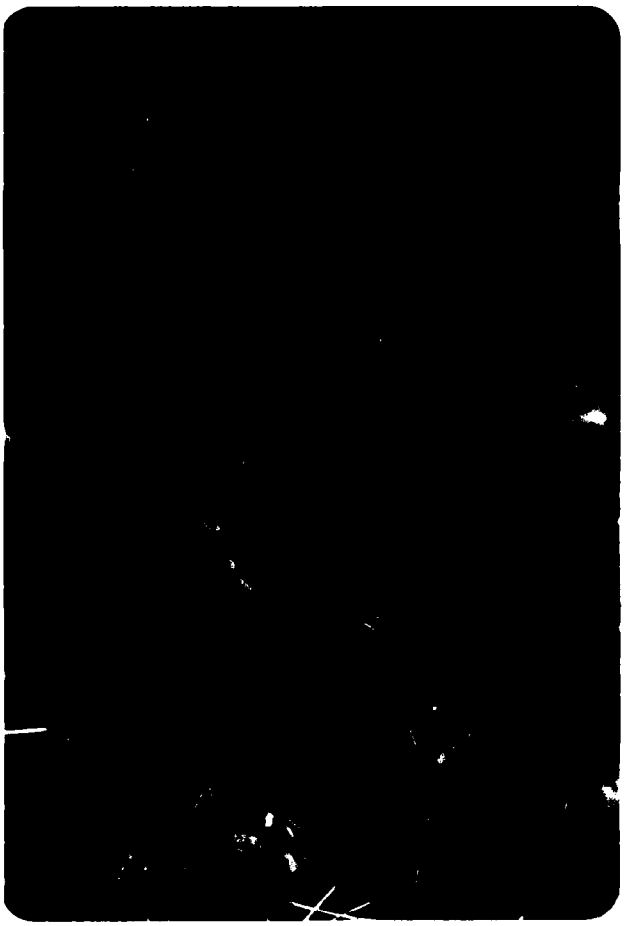


PHOTO INDEX 5
FOR
SEEPAGE

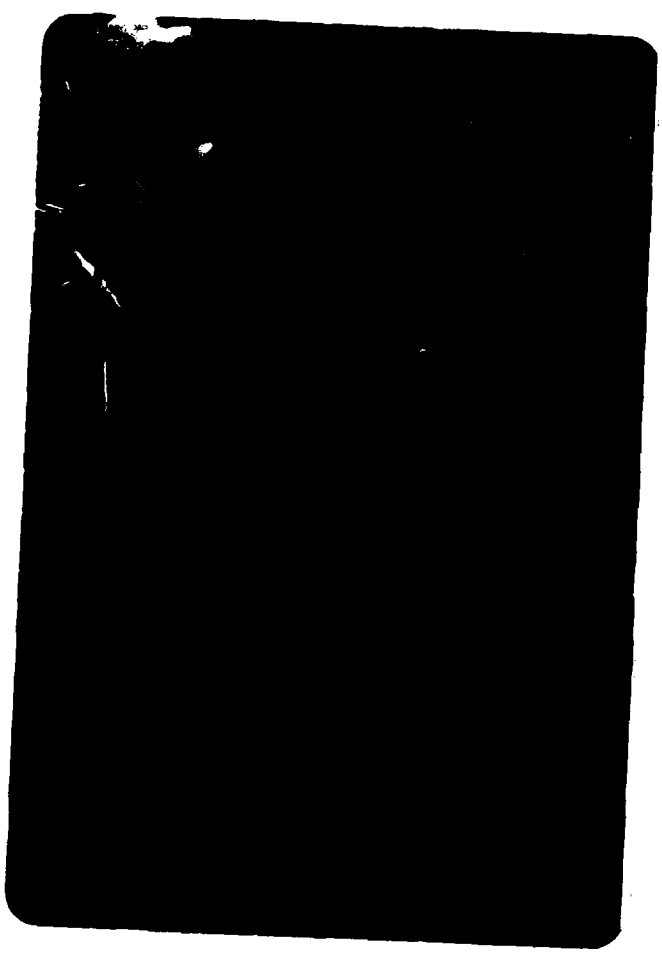
WIGGINS OZARK CAMP DAM
REYNOLDS COUNTY, MO.
DECEMBER 1978

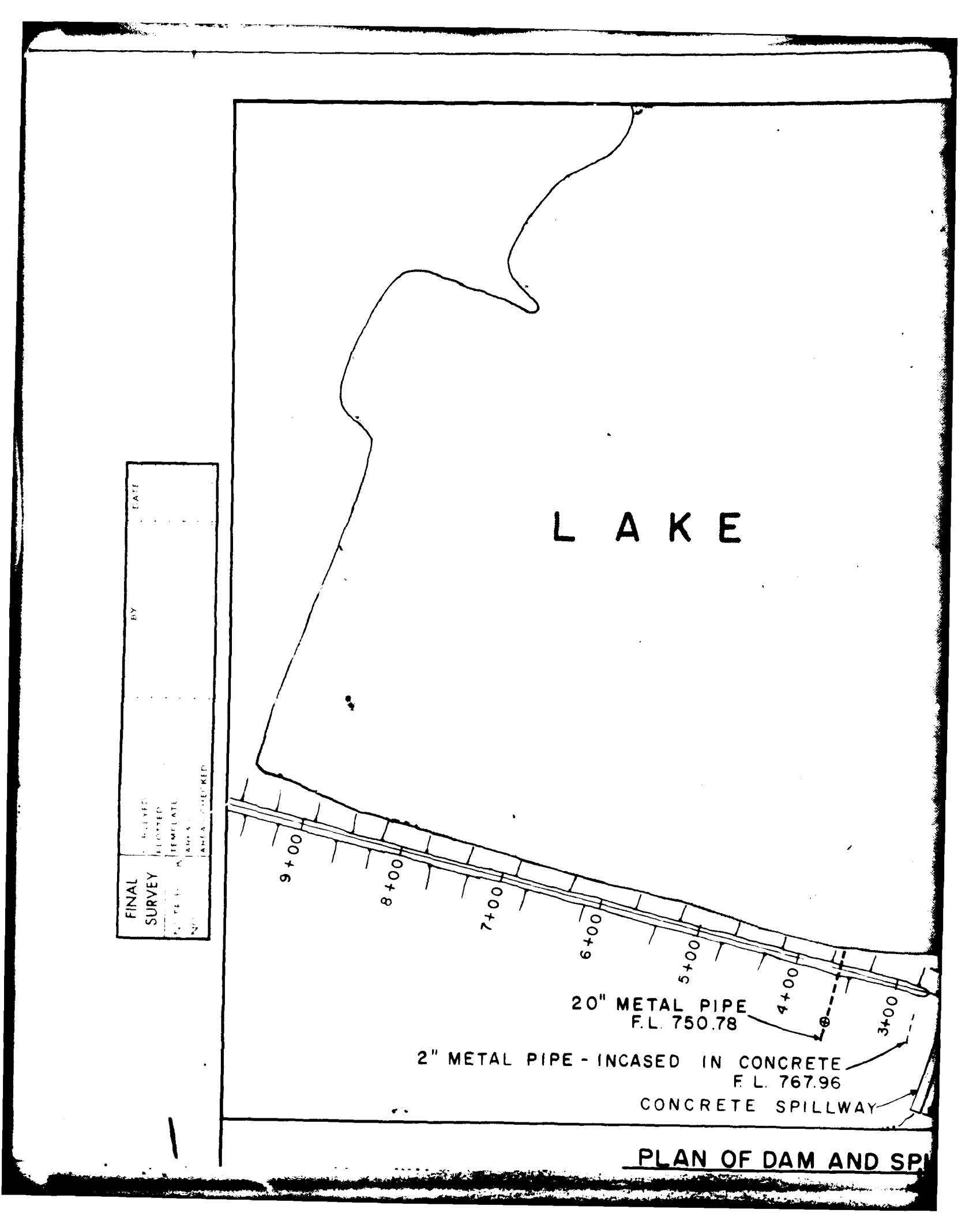
PREPARED BY
REITZ & JENS, INC

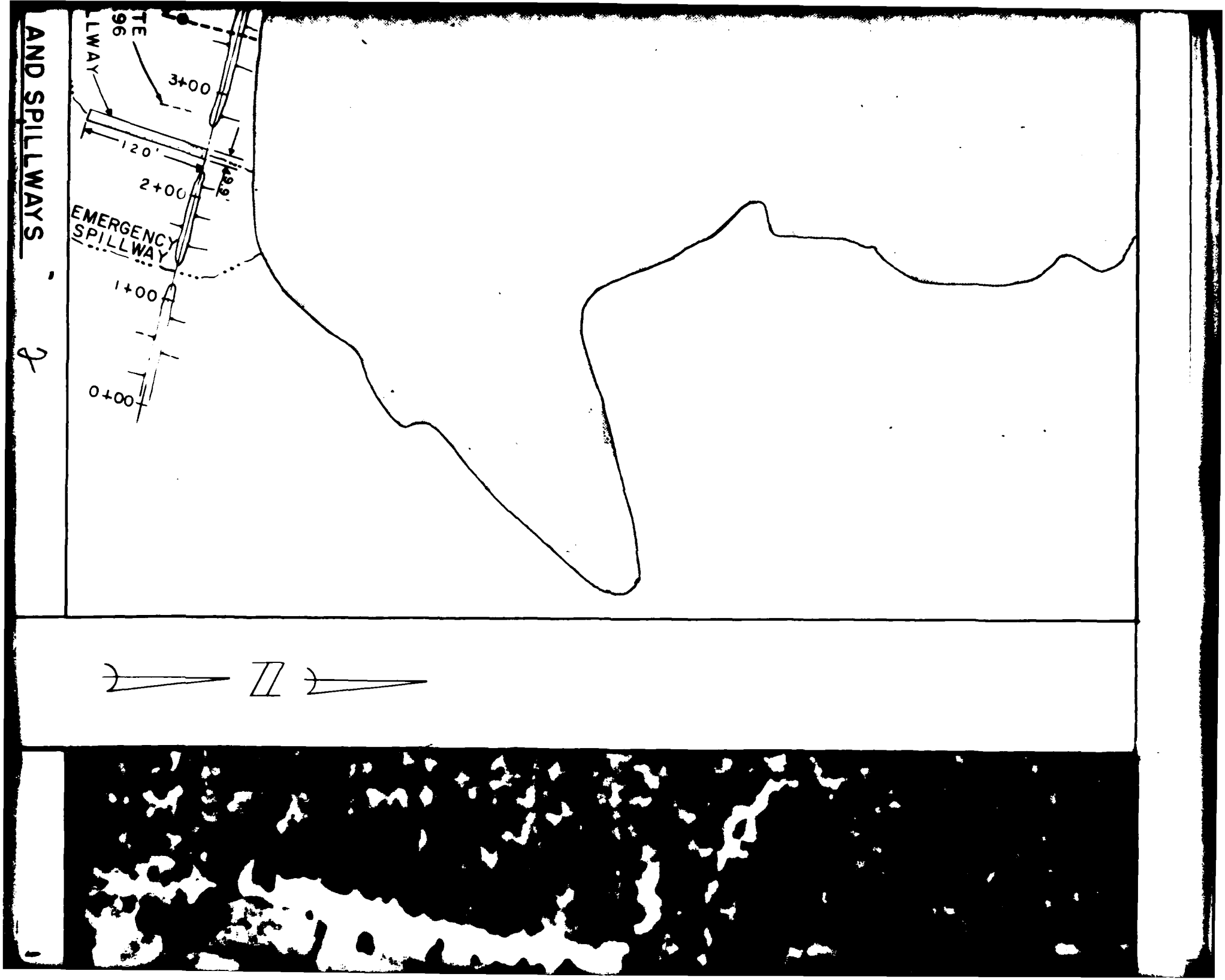




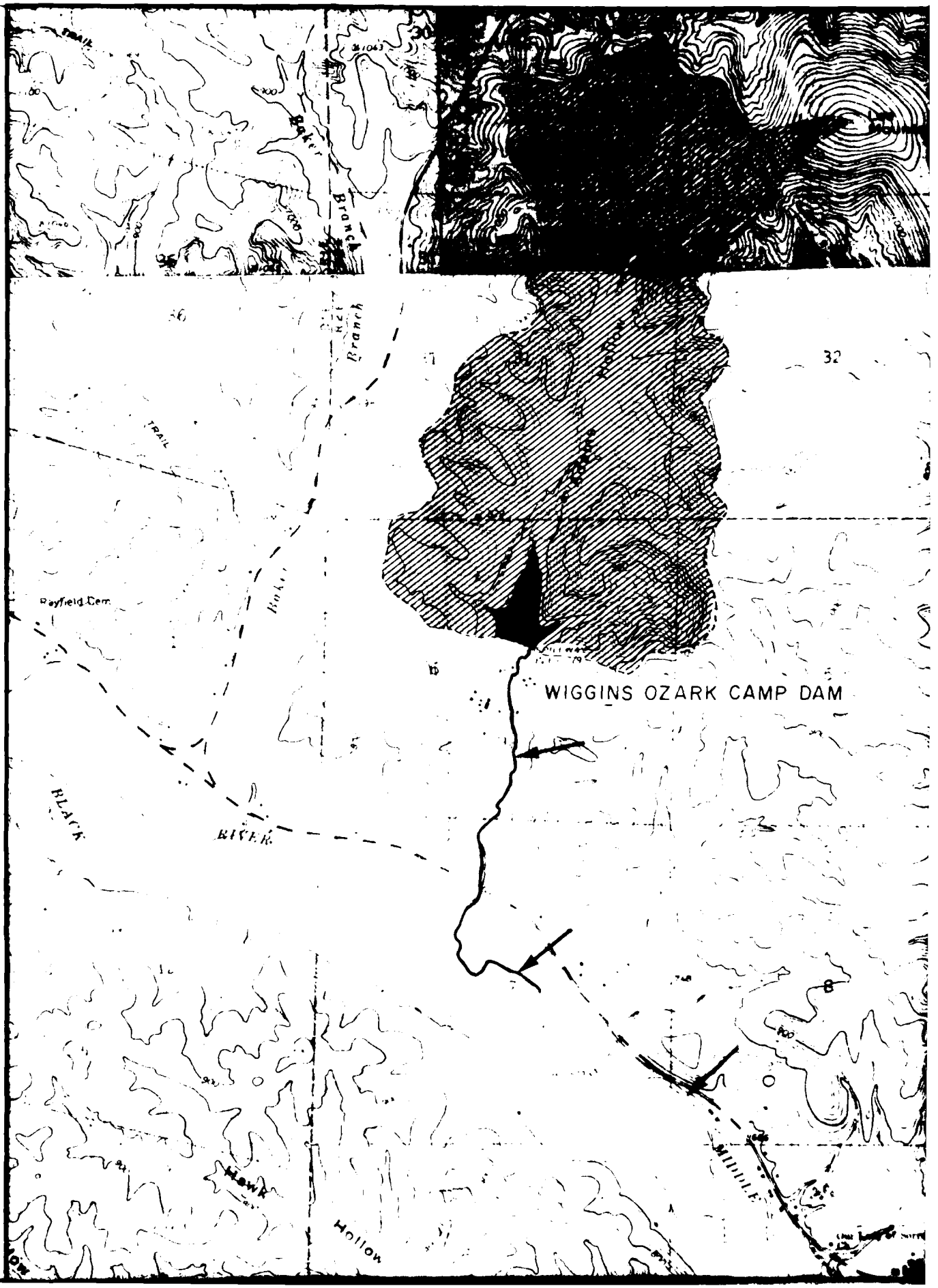

SEEPAGE

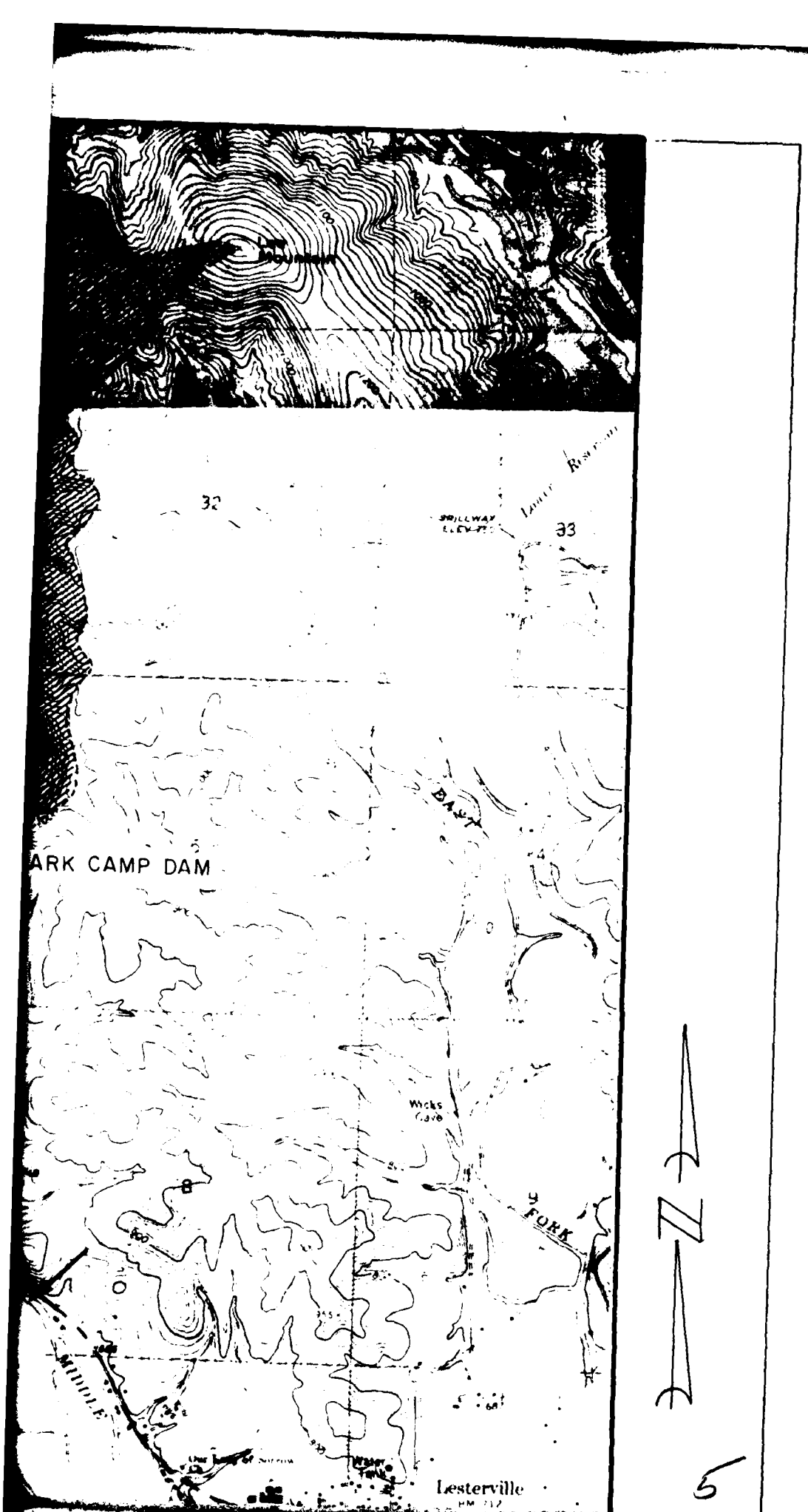



LAKE
FINAL SURVEY
DATE
BY
9+00
8+00
7+00
6+00
5+00
4+00
3+00
20" METAL PIPE
F.L. 750.78
2" METAL PIPE - INCASED IN CONCRETE
F.L. 767.96
CONCRETE SPILLWAY
PLAN OF DAM AND SP


AND SPILLWAYS
TE
96
LWAY
3+00
120'
2+00
EMERGENCY
SPILLWAY
1+00
0+00

13 PLAN OF LAKE

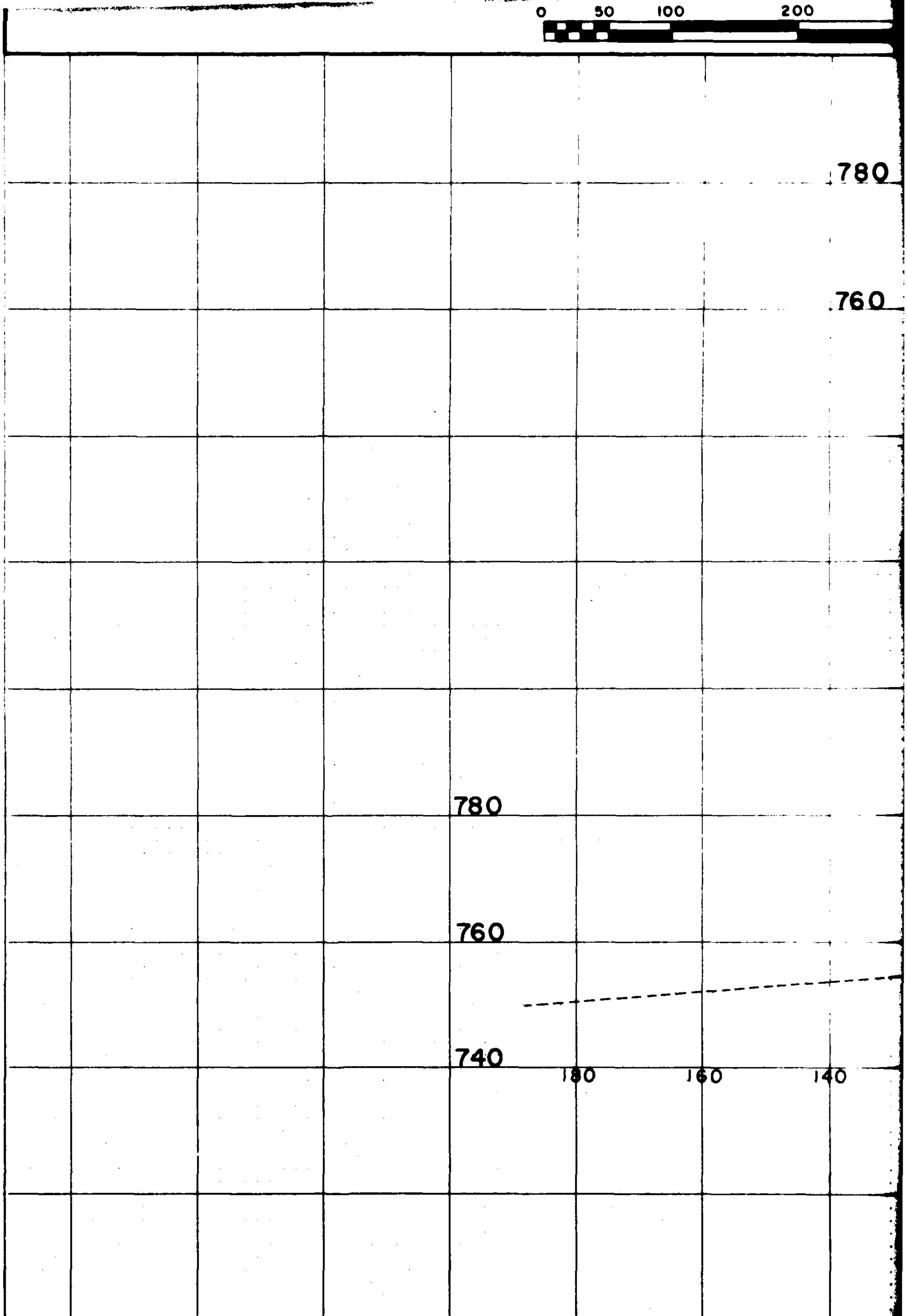

WIGGINS OZARK CAMP DAM
Baker Branch
Hill Branch
TRAIL
Bayfield Dam
BLACK
RIVER
Hollow
32


32
33
SPILLWAY ELEV.
DAM
ARK CAMP DAM
Wicks Cave
FORK
Lesterville
N
5

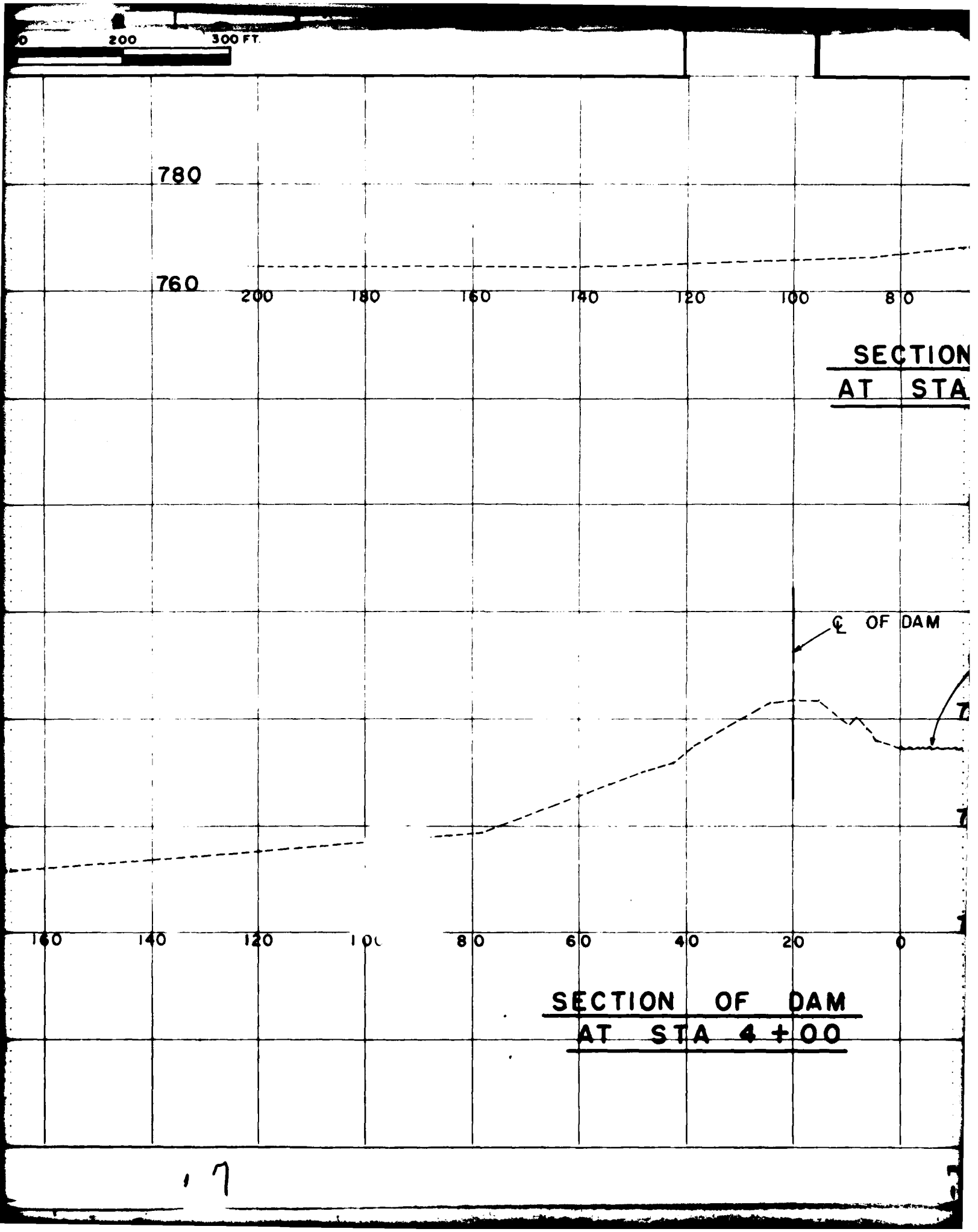
ORIGINAL SURVEY

	BY	DATE
SURVEYED		
PLOTTED		
TEMPLATE		
AREAS		
AREAS CHECKED		

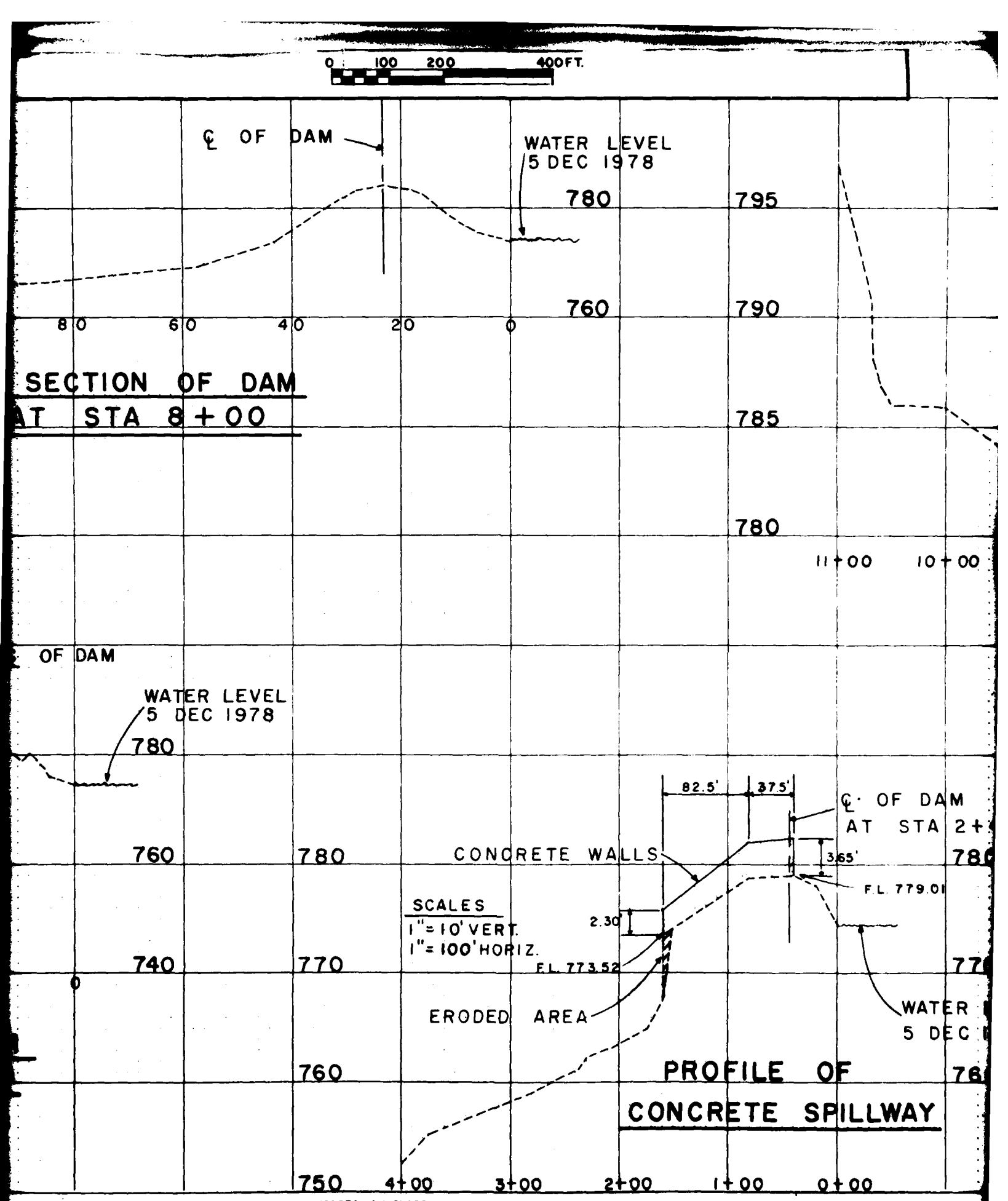
NOTE BOOK NO.



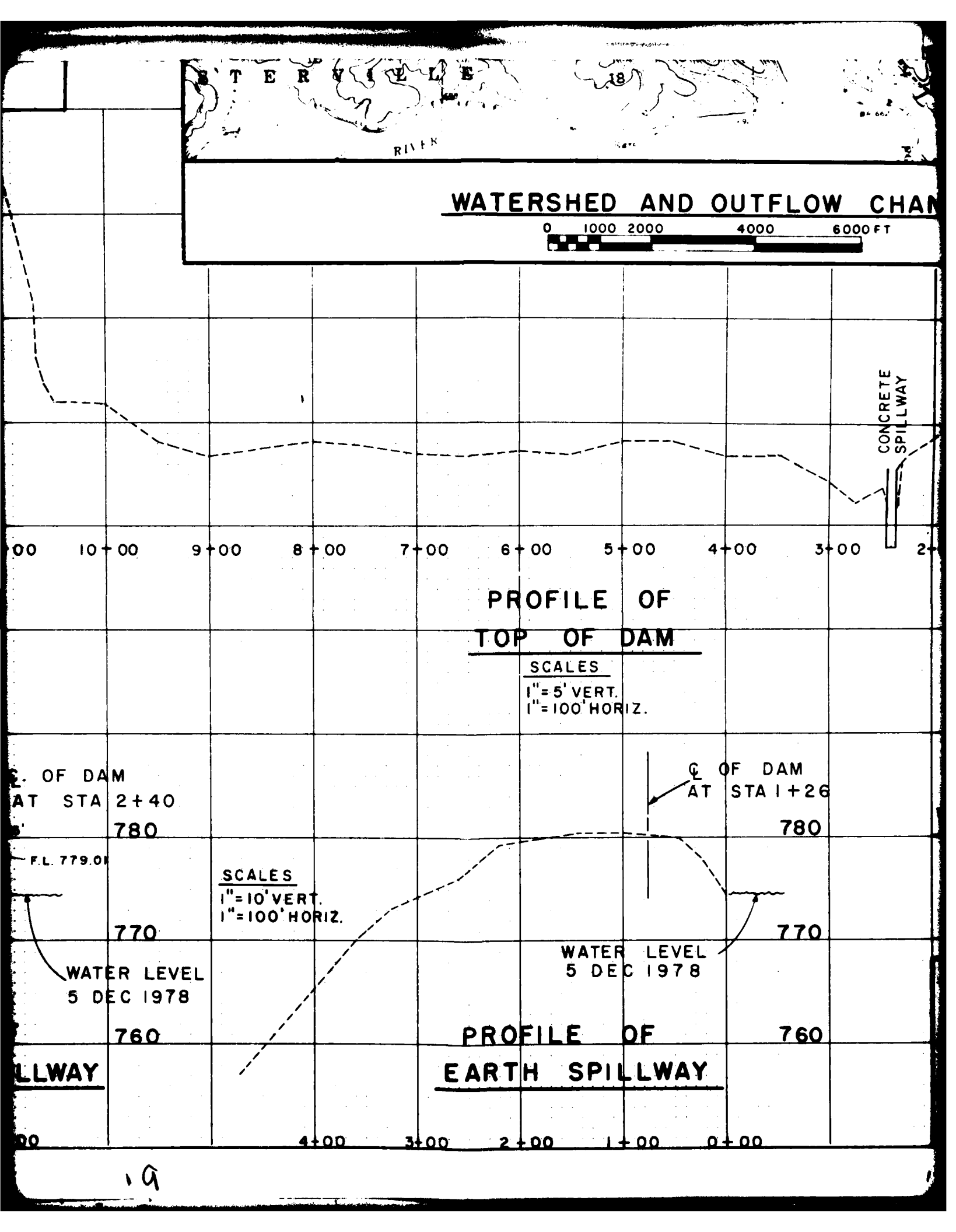
6

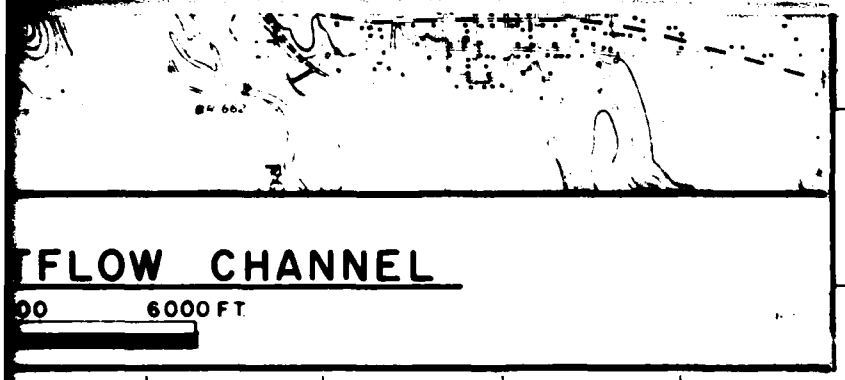


SECTION OF DAM
AT STA 4+00



HIGHWAY FEDERAL AID SHEET
PLATE 4-SINGLE PLAN AND CROSS SECTION-LINE & DOT
TELEDYNE NATIONAL TRACING PAPER
INDIANAPOLIS, INDIANA
PRINTED IN U.S.A.


STERVILLE
18
RIVER
WATERSHED AND OUTFLOW CHAN
0 1000 2000 4000 6000 FT
CONCRETE SPILLWAY
00 10+00 9+00 8+00 7+00 6+00 5+00 4+00 3+00 2+
PROFILE OF TOP OF DAM
SCALES
1"=5' VERT.
1"=100' HORIZ.
℄ OF DAM AT STA 2+40
℄ OF DAM AT STA 1+26
780
F.L. 779.0
SCALES
1"=10' VERT.
1"=100' HORIZ.
770
WATER LEVEL 5 DEC 1978
760
LLWAY
PROFILE OF EARTH SPILLWAY
00 4+00 3+00 2+00 1+00 0+00



TFLOW CHANNEL

00 6000 FT

795

790

785

780

CONCRETE SPILLWAY

EARTH SPILLWAY

3+00 2+00 1+00 0+00

DAM
A 1+26

780

770

760

WIGGINS OZARK CAMP DAM

PHASE I — INSPECTION

COUNTY I.D. NO 179

REYNOLDS COUNTY, MISSOURI

INVENTORY NO. I. D. 30026

FOR ST. LOUIS DISTRICT, CORPS OF ENGINEERS

REITZ & JENS, INC.
CONSULTING ENGINEERS

ST. LOUIS, MISSOURI
JANUARY 1979